

SERVICE MANUAL

for
Model 1525 and 1530

Delayed Trigger

DUAL-TRACE OSCILLOSCOPE



TEST INSTRUMENT SAFETY

WARNING

Normal use of test equipment exposes you to a certain amount of danger from electrical shock because testing must often be performed where exposed high voltage is present. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher voltage poses an even greater threat because such voltage can more easily produce a lethal current. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

1. Don't expose high voltage needlessly in the equipment under test. Remove housings and covers only when necessary. Turn off equipment while making test connections in high-voltage circuits. Discharge high-voltage capacitors after removing power.
2. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
3. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; make certain such surfaces are not damp or wet.
4. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
5. When using a probe, touch only the insulated portion. Never touch the exposed tip portion.
6. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as the on-off switch, fuses, power transformer, etc. any time the equipment is connected to an ac outlet, even if the equipment is turned off.
7. Some equipment with a two-wire ac power cord, including some with polarized power plugs, is the "hot chassis" type. This includes most recent television receivers and audio equipment. A plastic or wooden cabinet insulates the chassis to protect the customer. When the cabinet is removed for servicing, a serious shock hazard exists if the chassis is touched. Not only does this present a dangerous shock hazard, but damage to test instruments or the equipment under test may result from connecting the ground lead of most test instruments (including this oscilloscope) to a "hot chassis". To make measurements in "hot chassis" equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The **B & K-Precision** Model TR-110 Isolation Transformer, or Model 1653 or 1655 AC Power Supply is suitable for most applications. To be on the safe side, treat all two-wire ac powered equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.
8. Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

SERVICE MANUAL

for

B & K-PRECISION

Models 1525 and 1530

DUAL-TRACE OSCILLOSCOPE

WARNING

This service manual is intended for use by qualified electronics technicians only. To avoid electric shock, do not perform servicing unless you are qualified to do so.

High voltages up to 6000 V dc are present when this instrument is operating. Line voltage (120 or 240 Vac) is present on the power input circuit whenever the ac power cord is connected to a live outlet, even if the scope is turned off. Observe all high voltage safety precautions when the housing is removed from the oscilloscope. Contacting exposed high voltage could result in fatal electric shock.

B+K PRECISION **DYNASCAN**
CORPORATION

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Use this address for technical inquiries and replacement parts orders.

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LIST OF REFERENCE PUBLICATIONS

Model 1525 Instruction Manual	480-348-9-001
Model 1530 Instruction Manual	480-283-9-001
Model 1525 Composite (Schematic Diagram & Parts List)	499-233-9-001
Model 1530 Composite (Schematic Diagram & Parts List)	499-178-9-001

DIFFERENCES BETWEEN MODELS

SIMILARITIES

This manual covers the service and maintenance of the **B & K-Precision** Model 1525 and 1530 oscilloscopes. Both models use essentially the same circuit configuration and most of the service information applies equally to both models. The major features of these oscilloscopes are:

Delayed Sweep. Permits closer examination of any portion of waveform. Sweep trigger may be delayed from 1 microsecond to 100 milliseconds, independent of sweep rate.

Alternate Delayed Trigger. In alternate dual trace operation either channel A or channel B trace may be delayed while the other trace is not delayed for reference.

Intensified Delayed Sweep. Selectable intensity modulation brightens delayed portion of sweep for convenient identification of delayed sweep beginning point.

Dual Trace. Two waveforms can be displayed either singly or simultaneously. Chop or alternate method of dual trace automatically selected by sweep speed control or can be manually overridden.

Triggered Sweep. Either channel may be used as a sweep trigger. Level control either sets the point of triggering or sets an amplitude that must be met to obtain a sweep.

Alternate Triggering. In alternate Dual Trace Mode, the channel A trace can be triggered by the channel A signal and the channel B trace can be triggered by the channel B signal. Permits viewing of two

waveforms not related in frequency or period.

Auto Sweep. Provides sweep when no trigger signal is applied. Automatically reverts to triggered sweep when a signal is applied.

Holdoff. Variable "holdoff" period after sweep during which trigger for next sweep is inhibited. Permits synchronization of complex wave train.

LF and HF Reject Trigger Coupling. Selectable filters attenuate high or low frequency component of trigger for less jitter.

Video Sync. Selectable FRAME-LINE circuit permits triggering from vertical sync pulses (LINE) to view composite video waveforms.

High Sensitivity. 5 mV/div sensitivity permits the use of low-capacitance, high-impedance probes. Selectable 2 mV/div at decreased bandwidth.

Sum and Difference Capability. Input from both channels may be algebraically added or subtracted for differential voltage measurements.

Calibration Source. A 0.5 V, 1kHz square wave is provided to aid in scope checking and probe compensation.

20 Sweep Speeds. Allows for calibrated time measurements from 0.2 μ s/div to 0.5 s/div.

Z-Axis Input. Intensity modulation permits time or frequency marking from a TTL source.

DIFFERENCES

Unless otherwise noted, all information in this manual applies equally to Model 1525 and 1530. Any differences in the models will be noted as they apply. Major differences are described below and part by part differences are itemized in the parts list.

Model 1530 is a 30 MHz delayed trigger dual trace oscilloscope with a rise time of 11.7 ns. Model 1525 is a lower cost version with many of the design features of Model 1530. Its bandwidth is 20 MHz, with a rise time of 17.5 ns and two of the convenience features are omitted. Major differences between the two models are as follows:

Vertical Output Amplifier

Model 1530 uses a vertical output amplifier board (X73-1220-02 for earlier units and X73-1220-03 for later units) with a 30 MHz bandwidth, compared to the simpler 20 MHz version (X73-1220-05) in Model 1525. Several differences will be noted by comparing schematic diagrams.

Single Sweep Feature

The single sweep mode is included only in Model 1530. Correspondingly, the SINGLE/-RESET/NORM switch and all associated circuitry on the sweep board is omitted in Model 1525.

FIX Mode

This feature, which automatically sets the triggering level as the amplitude of the triggering signal changes, is included only in Model 1530. Thus, the PULL FIX switch and all associated circuitry on the sweep board is omitted in the more economical Model 1525.

Production Changes

The Model 1530 was first introduced in 1980. Several production changes were implemented into the Model 1530 before the introduction of the Model 1525 in 1982. The HISTORY OF PRODUCTION CHANGES section of this manual itemizes these changes for the convenience of technicians servicing earlier vintage scopes.

SPECIFICATIONS

MODEL 1530

VERTICAL AMPLIFIERS (CH A and CH B)

Deflection Factor

5 mV/div to 5 V/div $\pm 3\%$, 2mV/div $\pm 3\%$ attenuated in 10 steps, 5 mV/div to 5V/div in 1-2-5 sequence. Vernier control for fully adjustable sensitivity between steps. Amplifier gain change for 2 mV/div step.

Frequency Response

5mV/div to 5 V/div

DC: dc to 30 MHz (-3 dB).

AC: 5 Hz to 30 MHz (-3 dB).

2 mV/div

DC: dc to 20 MHz (-3 dB).

AC: 5 Hz to 20 MHz (-3 dB).

Rise Time

11.7 ns or less, 17.5 ns or less at 2 mV/div sensitivity.

Overshoot

3% or less (100 kHz square wave).

Input Impedance

1 M Ω $\pm 2\%$, shunted by 23 pF ± 3 pF.

Non-Distorted Maximum Amplitude

More than 8 div, dc to 30 MHz.

Maximum Input Voltage

300 V (dc + ac peak), 600 V p-p.

Operating Modes

CH A, CH B, DUAL, ADD, and subtract (using CH B invert).

Alternate-Chop Selection

TRIG SOURCE in ALT position:

Alternate trace at all sweep speeds.

TRIG SOURCE any position other than ALT:

Alternate and chop automatically selected with sweep speed. Trace chopped at all speeds with PULL CHOP.

MODEL 1525

VERTICAL AMPLIFIERS (CH A and CH B)

Deflection Factor

5 mV/div to 5 V/div $\pm 3\%$, 2mV/div $\pm 3\%$ attenuated in 10 steps, 5 mV/div to 5V/div in 1-2-5 sequence. Vernier control for fully adjustable sensitivity between steps. Amplifier gain change for 2 mV/div step.

Frequency Response

5mV/div to 0.2 V/div

DC: dc to 20 MHz (-3 dB).

AC: 5 Hz to 20 MHz (-3 dB).

2 mV/div

DC: dc to 15 MHz (-3 dB).

AC: 5 Hz to 15 MHz (-3 dB).

Rise Time

17.5 ns or less, 23.5 ns or less at 2 mV/div sensitivity.

Overshoot

3% or less (100 kHz square wave).

Input Impedance

1 M Ω $\pm 2\%$, shunted by 23 pF ± 3 pF.

Non-Distorted Maximum Amplitude

More than 8 div, dc to 20 MHz.

Maximum Input Voltage

300 V (dc + ac peak), 600 V p-p.

Operating Modes

CH A, CH B, DUAL, ADD, and subtract (using CH B invert).

Alternate-Chop Selection

TRIG SOURCE in ALT position:

Alternate trace at all sweep speeds.

TRIG SOURCE any position other than ALT:

Alternate and chop automatically selected with sweep speed. Trace chopped at all speeds with PULL CHOP.

SPECIFICATIONS

MODEL 1530

Chop Frequency

Approximately 200 kHz.

Channel B Polarity

Normal or inverted.

Channel Separation

60 dB minimum.

HORIZONTAL AMPLIFIER (input thru CH B)**X-Y Operation**

With SWEEP TIME/DIV switch in CH B position, CH A input becomes Y axis (vertical) and CH B input becomes X axis (horizontal).

Deflection Factor

Same as vertical amplifier.

Input Impedance

Same as vertical amplifier.

Maximum Input Voltage

Same as vertical amplifier.

Frequency Response

DC: dc to 2 MHz (-3dB).

AC: 5 Hz to 2 MHz (-3 dB).

X-Y Phase Difference

3° or less at 100 kHz.

TIME BASE**Type**

Normal: triggered sweep.

Automatic: sweep free runs in absence of trigger, reverts to triggered sweep in presence of trigger.

Single: when triggered, one sweep is generated; Manually reset.

Sweep Time

0.2 μ s/div to 0.5 s/div $\pm$ 3% in 20 ranges, in 1-2-5 sequence. Vernier control provides fully adjustable sweep time between steps.

Sweep Magnification

X5 (five times) $\pm$ 10%. Extends maximum sweep rate to 40 ns/div.

MODEL 1525

Chop Frequency

Approximately 200 kHz.

Channel B Polarity

Normal or inverted.

Channel Separation

60 dB minimum.

HORIZONTAL AMPLIFIER (input thru CH B)**X-Y Operation**

With SWEEP TIME/DIV switch in CH B position, CH A input becomes Y axis (vertical) and CH B input becomes X axis (horizontal).

Deflection Factor

Same as vertical amplifier.

Input Impedance

Same as vertical amplifier.

Maximum Input Voltage

Same as vertical amplifier.

Frequency Response

DC: dc to 2 MHz (-3dB).

AC: 5 Hz to 2 MHz (-3 dB).

X-Y Phase Difference

3° or less at 100 kHz.

TIME BASE**Type**

Normal: triggered sweep.

Automatic: sweep free runs in absence of trigger, reverts to triggered sweep in presence of trigger.

Single: when triggered, one sweep is generated; Manually reset.

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Sweep Magnification

X5 (five times) $\pm$ 10%. Extends maximum sweep rate to 40 ns/div.

MODEL 1530**Linearity**

$\pm 3\%$ all ranges ($\pm 10\%$ on 0.5 $\mu\text{s}/\text{div}$ and 0.2 $\mu\text{s}/\text{div}$ range at 5X magnification).

DELAYED SWEEP**Delay Time**

1 μs to 100 ms in 5 ranges with vernier adjustment.

Intensity Modulation

INTEN switch allows portion of sweep after delay to be intensified.

Independent Delay

With ALT triggering source, channel A or channel B sweep can be independently delayed.

Delay Jitter

Less than 1 part in 5000.

TRIGGERING**Source**

Alternate, channel A, channel B, line (50/60 Hz power line), and external.

Type

Normal, automatic, and single.

Slope

Positive or negative.

Level

Continuously variable or fixed. In FIX mode, level is automatically fixed at center of sync waveform.

Hold Off

Continuously variable from NORM to more than 10 times (MAX).

Coupling

AC, LF reject, HF reject, DC.

Video

FRAME-LINE switch permits triggering from horizontal (LINE) or vertical (FRAME) sync pulses of composite video signal.

MODEL 1525**Linearity**

$\pm 3\%$ all ranges ($\pm 10\%$ on 0.5 $\mu\text{s}/\text{div}$ and 0.2 $\mu\text{s}/\text{div}$ range at 5X magnification).

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1 μs to 100 ms in 5 ranges with vernier adjustment.

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INTEN switch allows portion of sweep after delay to be intensified.

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With ALT triggering source, channel A or channel B sweep can be independently delayed.

Delay Jitter

Less than 1 part in 5000.

TRIGGERING**Source**

Alternate, channel A, channel B, line (50/60 Hz power line), and external.

Type

Normal and automatic.

Slope

Positive or negative.

Level

Continuously variable.

Hold Off

Continuously variable from NORM to more than 10 times (MAX).

Coupling

AC, LF reject, HF reject, DC.

Video

FRAME-LINE switch permits triggering from horizontal (LINE) or vertical (FRAME) sync pulses of composite video signal.

SPECIFICATIONS

MODEL 1530

Maximum External Trigger Voltage
50 V (dc + ac peak).

TRIGGER SENSITIVITY

COUP- LING	BANDWIDTH	Minimum Trigger Voltage	
		INT (div)	EXT (V p-p)
AC	20 Hz to 25 MHz	0.5	1
	10 Hz to 30 MHz	1.0	5
DC	DC to 25 MHz	0.5	1
	DC to 30 MHz	1.0	5
FIX	40 Hz to 20 MHz	0.5	1
	20 Hz to 25 MHz	1.0	5
LF Rej: Attenuate below 10 kHz.			
HF Rej: Attenuate above 100 kHz.			

Z-AXIS INPUT (Intensity Modulation)

Sensitivity

2 V p-p minimum (TTL compatible). Positive voltage increases brightness, negative voltage decreases brightness.

Usable Frequency Range

DC to 5 MHz.

Input Impedance

10 k Ω .

Maximum Input Voltage

50 V (dc + ac peak).

POWER REQUIREMENTS

Input

120/240 VAC, 50/60 Hz, 30 watts.

Regulation

105 to 130 VAC.

210 to 260 VAC.

OTHER SPECIFICATIONS

Trace Rotation

Electrical, adjustable from front panel.

MODEL 1525

Maximum External Trigger Voltage
50 V (dc + ac peak).

TRIGGER SENSITIVITY

COUP- LING	BANDWIDTH	Minimum Trigger Voltage	
		INT (div)	EXT (V p-p)
AC	20 Hz to 15 MHz	0.5	1
	10 Hz to 20 MHz	1.0	5
DC	DC to 15 MHz	0.5	1
	DC to 20 MHz	1.0	5
LF Rej: Attenuate below 10 kHz.			
HF Rej: Attenuate above 100 kHz.			

Z-AXIS INPUT (Intensity Modulation)

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2 V p-p minimum (TTL compatible). Positive voltage increases brightness, negative voltage decreases brightness.

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Input

120/240 VAC, 50/60 Hz, 30 watts.

Regulation

105 to 130 VAC.

210 to 260 VAC.

OTHER SPECIFICATIONS

Trace Rotation

Electrical, adjustable from front panel.

MODEL 1530

CRT (Figs. 1 and 2).

140 mm rectangular CRT (approx. 5"), internal 8 x 10 division graticule, 1 division = 9.5 mm.

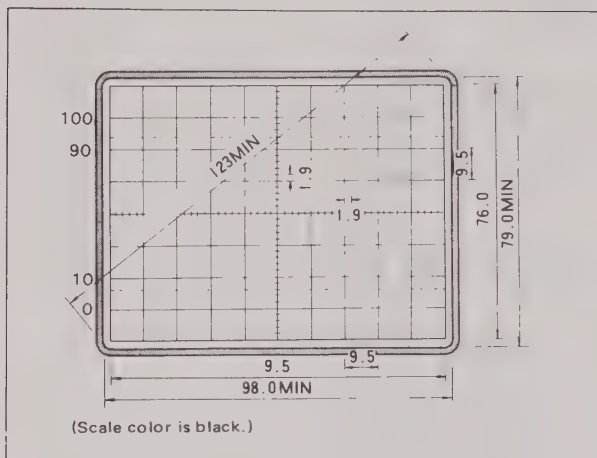


Fig. 1. CRT Dimensions

Acceleration Voltage

6 kV.

Calibration Voltage

0.5 V P-P +1% square wave; positive polarity, reference level 0 V; 1 kHz +3%.

Dimensions (HWD), without Handle (Fig. 3).

19 x 26 x 37.5 cm (7-3/8 x 10-1/8 x 14-3/4").

Weight

8.6 kg (19 lbs.).

CRT 140CGB31 SPECIFICATIONS

Dimensions

Overall Length

310 mm or less.

Face Plate Dimensions

143.5 + 1.5 mm maximum.

Screen Shape

Rectangular, flat face, internal graticule.

MODEL 1525

CRT (Figs. 1 and 2).

140 mm rectangular CRT (approx. 5"), internal 8 x 10 division graticule, 1 division = 9.5 mm.

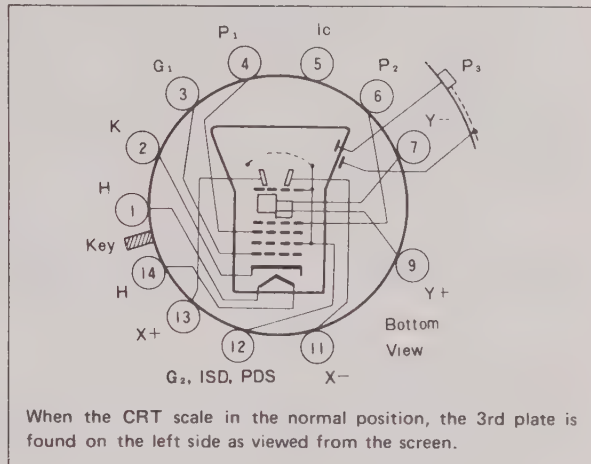


Fig. 2. CRT Basing Diagram.

Acceleration Voltage

6 kV.

Calibration Voltage

0.5 V P-P +1% square wave; positive polarity, reference level 0 V; 1 kHz +3%.

Dimensions (HWD), without Handle (Fig. 3).

19 x 26 x 37.5 cm (7-3/8 x 10-1/8 x 14-3/4").

Weight

8.6 kg (19 lbs.).

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Dimensions

Overall Length

310 mm or less.

Face Plate Dimensions

143.5 + 1.5 mm maximum.

Screen Shape

Rectangular, flat face, internal graticule.

SPECIFICATIONS

MODEL 1530

Deflection and Focusing System

Electrostatic deflection. Electrostatic Focusing. Post-deflection acceleration.

Color

Green.

Persistence

Medium short.

Heater Voltage

6.3 V.

Heater Current

0.24 A.

3rd Plate Voltage (Eb3)

6.3 V maximum.

2nd Plate Voltage (Eb2)

1800 V maximum.

2nd Grid Voltage (Ec2)

1700 V maximum.

1st Grid Voltage (Ec1)

200 V maximum.

Cathode to Heater Voltage (Ehk)

125 V maximum.

Voltage Between 2nd Plate and Any Deflection Plate

500 V maximum.

Display Area

95.0 x 76.0 mm².

MODEL 1525

Deflection and Focusing System

Electrostatic deflection. Electrostatic Focusing. Post-deflection acceleration.

Color

Green.

Persistence

Medium short.

Heater Voltage

6.3 V.

Heater Current

0.24 A.

3rd Plate Voltage (Eb3)

6.3 V maximum.

2nd Plate Voltage (Eb2)

1800 V maximum.

2nd Grid Voltage (Ec2)

1700 V maximum.

1st Grid Voltage (Ec1)

200 V maximum.

Cathode to Heater Voltage (Ehk)

125 V maximum.

Voltage Between 2nd Plate and Any Deflection Plate

500 V maximum.

Display Area

95.0 x 76.0 mm².

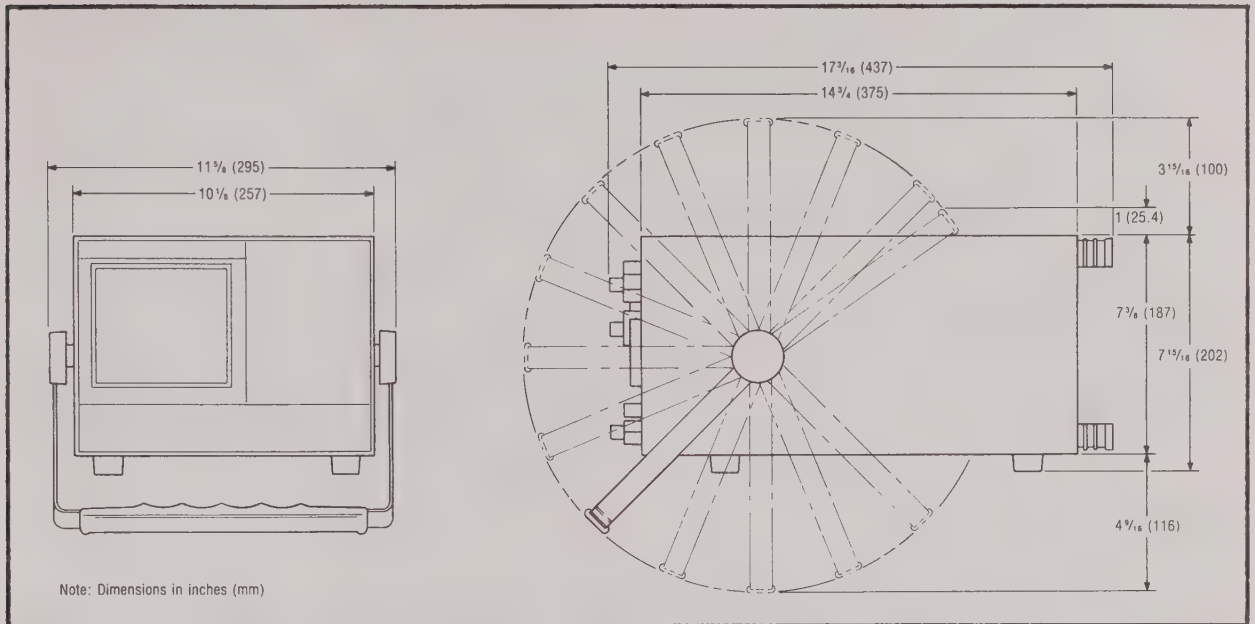


Fig. 3. Overall Dimensions.

ACCESSORIES

ACCESSORIES SUPPLIED

Two 10:1/Direct Probes.
Instruction Manual.
Composite (Schematic Diagram & Parts
List).

OPTIONAL ACCESSORIES

LC-74 Protective Cover.
PR-37 Deluxe 10:1/Direct Probes.
Connecting Cables.

MODEL LC-74 PROTECTIVE COVER

This rugged grained leatherette cover covers the front panel and provides lightweight, convenient protection while transporting the oscilloscope. A handy pocket provides stowage for probes.

CABLES

B & K-PRECISION offers several instrument cables that may be convenient if your oscilloscope is connected directly to other instruments (see Fig. 4).

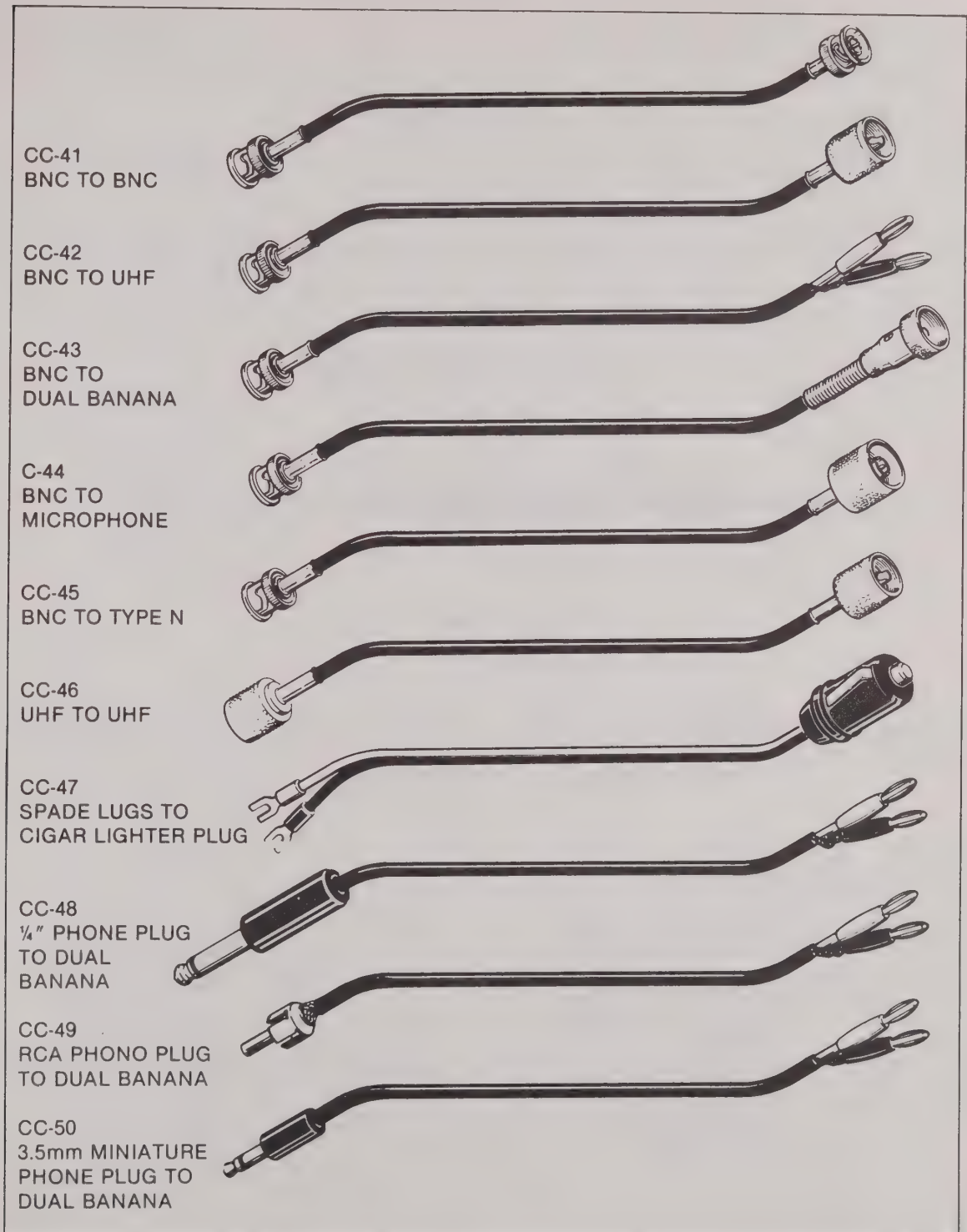
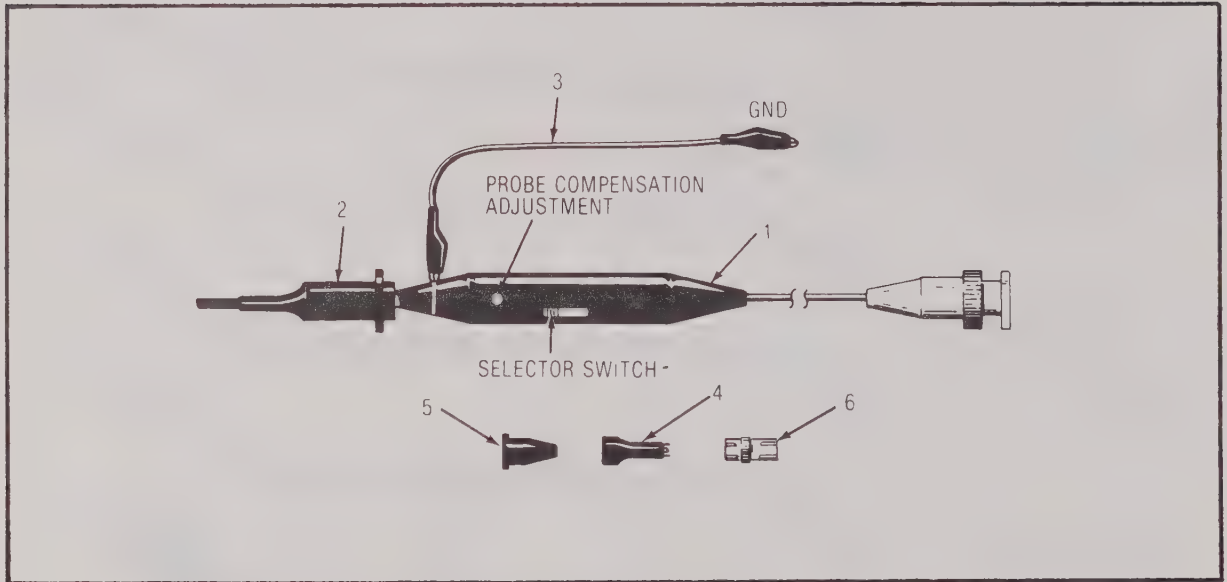


Fig. 4. Interconnect Cables.

PR-40 10:1/DIRECT PROBE



PR-40 10:1/Direct Probe.

ITEM	DESCRIPTION	PART NO.
	Complete PR-40 Probe with accessory tips	535-040-0-000
1	Probe & Cable Assembly	523-324-9-001
2	Spring Hook Assembly	523-316-9-001
3	Ground Wire Assembly	523-325-9-001
4	IC Tip	380-378-9-001
5	Insulating Tip	380-378-9-002
6	BNC Adapter	768-016-9-001
	Red Adhesive Strip	485-018-9-001
	Gray Adhesive Strip	485-018-9-002
	Instruction Sheet	481-121-9-001

SPECIFICATIONS

	10X position	1X position
Attenuation	10:1 $\pm 1\%$ (at oscilloscope input impedance of 1 M Ω $\pm 1\%$)	-
Input Impedance	10 M Ω $\pm 1\%$	1 M Ω $\pm 1\%$
Input Capacitance	less than 18 pF	less than 100 pF
Bandwidth	100 MHz	15 MHz
Rise Time	3.5 ns	24 ns
Compensation Range	15 to 40 pF	
Maximum Input Voltage	500 V p-p; 250 V dc + ac peak	

DESCRIPTION

The B & K-Precision Model PR-40 deluxe probe is designed for use with wideband oscilloscopes to 100 MHz. The PR-40 is a slim-body probe of precision lightweight construction. A three position switch selects 10:1 or direct modes, or a reference position that grounds the tip through a 9 megohm resistor.

Accessories included with the PR-40 are a spring-loaded retractable tip cover, insulating tip, BNC tip adapter, and IC tip. The insulating tip is designed for probing dense solid-state circuitry with little danger of shorting nearby components. The BNC adapter tip converts the probe tip into a push-on BNC fitting, ideal for interface with test points or output jacks. The IC tip guides the probe contact into any pin of a standard DIP, making it almost impossible to short two pins of an IC.

The PR-40 is supplied with both grey and red adhesive strips, which are particularly useful with a dual-trace scope for instant identification of the channel to which a probe is connected. The PR-40 and accessories come in a convenient vinyl case.

OPERATION

By setting the selector switch of the probe to the "1X" position, an unattenuated waveform can be observed. Note that bandwidth is 15 MHz in this position.

By setting the switch to the "10X" position, the probe input impedance is increased to 10 megohms and the waveform being observed is attenuated 10:1. The "10X" position must be used above 15 MHz and whenever the loading effect of the probe may disturb normal operation of a circuit. Signal attenuation is 10:1 when using the standard 1 megohm input impedance (use coaxial cable rather than the probe when terminated into 50 ohms). This high impedance probe will cause very little error in measurements in circuits of 1 megohm impedance or less.

The "REF" position of the probe selector switch opens the probe input and grounds the oscilloscope input, allowing convenient measurement of reference level.

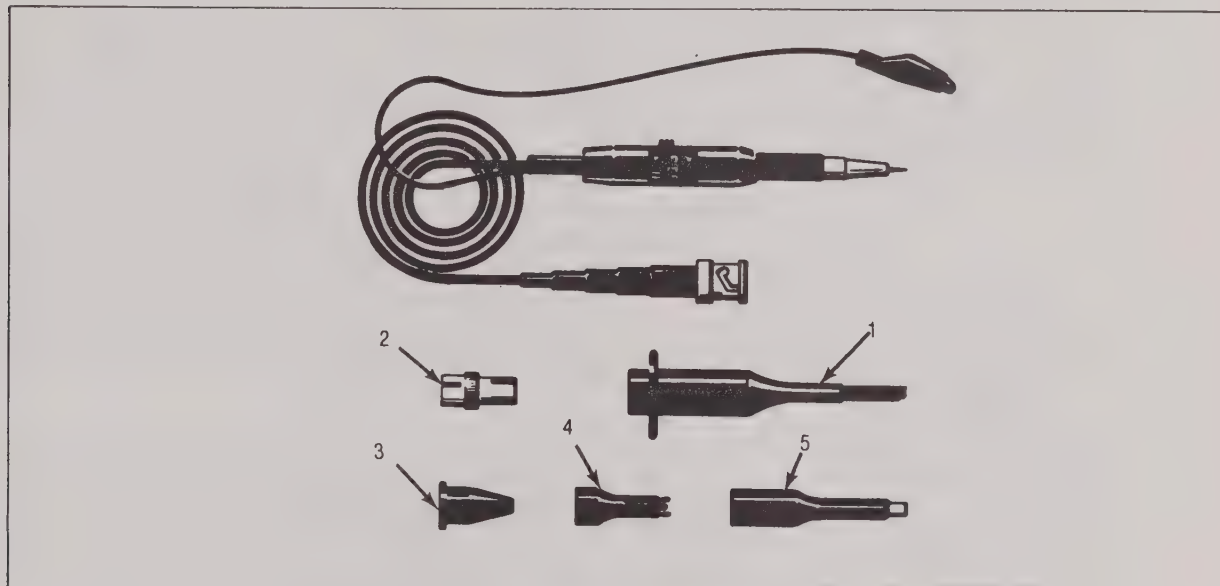
ADJUSTMENT

Set the probe selector switch to the "10X" position. Connect probe to vertical input of oscilloscope. Use the oscilloscope's most sensitive vertical attenuator setting and, while observing a 1 kHz or 10 kHz square wave signal, adjust the trimmer on the probe with an insulated screwdriver for best square wave presentation; that is, least overshoot, tilt, and rounding off of square wave.

SERVICING

The probe is not repairable. This includes both repairs to the main probe assembly and replacement of the special type coaxial cable. The impedance, capacitance, and bandwidth characteristics of the probe are very critical, and can only be assured by assembly at the factory. Servicing consists of probe compensation adjustment and replacement of those items listed in the parts list.

PR-37 DELUXE 10:1/DIRECT PROBE



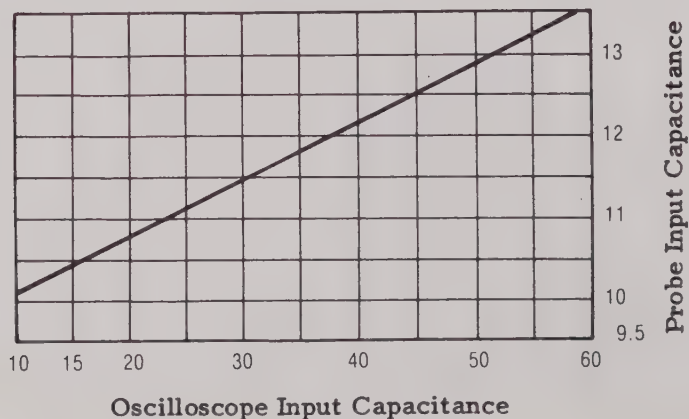
PR-37 Deluxe 10:1/Direct Probe.

ITEM	DESCRIPTION	PART NO.
	Complete Dual PR-37 Probe Set with accessory tips, 1 Gray and 1 Red	534-096-0-000
	Complete PR-37(G) Probe with accessory tips, Gray	534-097-0-000
	Complete PR-37(R) Probe with accessory tips, Red	534-098-0-000
1	Spring Hook Assembly, Gray	521-090-9-001
1	Spring Hook Assembly, Red	521-091-9-001
2	BNC Adapter	521-089-9-004
3	Insulating Tip	521-089-9-001
4	IC Tip	521-089-9-005
5	Trimmer Tool	521-089-9-003

SPECIFICATIONS

	10X position	1X position
Bandwidth	dc to 100 MHz	dc to 10 MHz
Rise Time	3.5 ns	35 ns
Input Impedance	10 M Ω $\pm$ 1% (when used with oscilloscopes with a 1 M Ω input)	1 M Ω (oscilloscope input)
Input Capacitance	11.5 pF (when used with oscilloscopes which have 30 pF input capacitance) *	40 pF (plus oscilloscope capacitance)
Compensation Range	10 to 60 pF	
Maximum Input Voltage	600 volts p-p or dc + ac peak	
REF Positon	probe grounded via 9 M Ω resistor, oscilloscope input grounded	
Connector	BNC	
Length	approx. 60"	

* = for other values see graph.



DESCRIPTION

The B&K-PRECISION Model PR-37 deluxe probe is designed for use with wideband oscilloscopes to 100 MHz. The PR-37 is a slim-body probe of precision lightweight construction. A three position switch selects 10:1 or direct modes, or a reference position that grounds the tip through a 9-megohm resistor. The 52" coaxial cable is extremely flexible.

Accessories included with the PR-37 are a spring-loaded retractable tip cover, insulating tip BNC tip adapter, IC tip and an insulated compensation capacitor adjustment tool. The insulating tip is designed for probing dense solid-state circuitry with little danger of shorting nearby components. The BNC adapter tip converts the probe tip into a push-on BNC fitting, ideal for interface with test points or output jacks. The IC tip guides the probe contact into any pin of a standard DIP, making it almost impossible to short two pins of an IC.

The PR-37 is available in both grey and red colors. Probes of different colors are particularly useful with a dual-trace scope for instant identification of the channel to which a probe is connected. The PR-37 and accessories come in convenient zippered vinyl case. Model PR-37G is grey and PR-37R is red.

OPERATION

By setting the selector switch of the probe to the "1X" position, an unattenuated waveform can be observed. Note that bandwidth is 10 MHz in this position.

By setting the switch to the "10X" position, the probe input impedance is increased to

10 megohms and the waveform being observed is attenuated 10:1. The "10X" position must be used above 10 MHz and whenever the loading effect of the probe may disturb normal operation of a circuit. Signal attenuation is 10:1 when using the standard 1 megohm input impedance (use coaxial cable rather than the probe when terminated into 50 ohms). This high impedance probe will cause very little error in measurements in circuits of 1 megohm impedance or less.

The "REF" position of the probe selector switch opens the probe input and grounds the oscilloscope input, allowing convenient display of reference level.

ADJUSTMENT

Set the probe selector switch to the "10X" position. Connect probe to vertical input of oscilloscope. Use the oscilloscope's most sensitive vertical attenuator setting and, while observing a 1 kHz or 10 kHz square wave signal, adjust the trimmer on the probe with an insulated screwdriver for best square wave presentation; that is, least overshoot, tilt, and rounding off of square wave.

SERVICING

The probe is not repairable. This includes both repairs to the main probe assembly and replacement of the special type coaxial cable. The impedance, capacitance, and bandwidth characteristics of the probe are very critical, and can only be assured by assembly at the factory. Servicing consists of probe compensation adjustment and replacement of those items listed in the parts list.

CONTROLS AND INDICATORS

All pushbutton switches on this oscilloscope are alternate action type. Press once to engage (button stays in). Press again to release (button returns to out position).

GENERAL CONTROLS (1-9) (See Fig. 5)

1. **MODE Switch.** Four-position lever switch; selects the basic operating modes of the oscilloscope.

CH A - Only the input signal to channel A is displayed as a single trace.

CH B - Only the input signal to channel B is displayed as a single trace.

DUAL - Dual-trace operation; both the channel A and channel B input signals are displayed on two separate traces.

ADD - The waveforms from channel A and channel B inputs are added and the sum is displayed as a single trace. When the CH B POLARITY button is engaged (INV), the waveform from channel B is subtracted from the channel A waveform and the difference is displayed as a single trace.

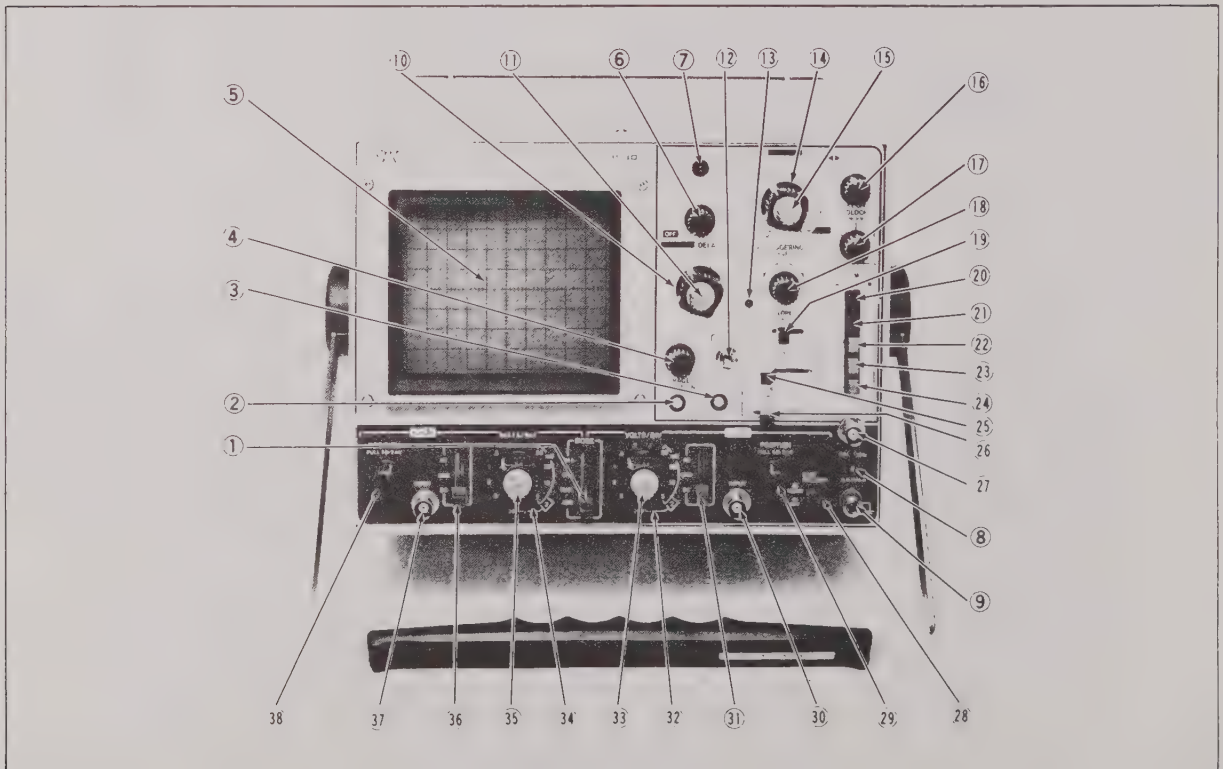


Fig. 5. Front Panel Controls and Indicators.

2. **TRACE ROTATION Control.** Electrically rotates trace to horizontal position.
3. **ASTIG Adjustment.** Astigmatism adjustment provides optimum spot roundness when used in conjunction with FOCUS and INTENSITY controls. Very little readjustment of this control is required after initial adjustment.
4. **FOCUS Control.**
5. **Cathode Ray Tube (CRT).** This is the screen on which the waveforms are viewed. This rectangular CRT has an internal 8 x 10 division graticule scale which reduces parallax error to minimum.
6. **INTENSITY Control.** Fully counterclockwise rotation of this control (OFF position) turns off oscilloscope. Clockwise rotation turns on oscilloscope. Further clockwise rotation of the control increases the brightness of the trace.
7. **POWER Indicator.** Glows when oscilloscope is turned on.
8. **CAL 1 kHz  0.5 V p-p Terminal.** Provides 1 kHz, 0.5-volt peak-to-peak square wave signal. This is useful for probe compensation adjustment and a general check of oscilloscope calibration accuracy.
9. ** Terminal/Binding Post.** Earth and chassis ground.
11. **Delay Time VARIABLE Control.** Fine adjustment of delay time within selected range. Fully counterclockwise rotation is minimum delay time, clockwise rotation increases delay time.
12. **SINGLE Switch.** (Model 1530 only) Three-position toggle switch with the following positions:

NORM - Normal sweep, used for all types of operation except single sweep.

center - Released position.

RESET - This is a momentary action position; switch returns to center position when released. Enables single sweep operation. A single sweep will begin when the next sync trigger occurs. After a single sweep, switch must be momentarily RESET to enable next single sweep. When held in RESET position, spot illumination brightens the entire CRT screen to accentuate the graticule scale for waveform photographs.
13. **Single READY Indicator.** (Model 1530 only) Lights to indicate single sweep operation is ready for triggering. Lights when RESET switch is operated and goes off when single sweep is completed.
14. **SWEEP TIME/DIV Switch.** Horizontal coarse sweep time selector. Selects calibrated sweep times of 0.2 μ s/div (microsecond per division) to 0.5 s/div in 20 steps when sweep time VARIABLE control is set to CAL position (fully clockwise). In the CH B position, this switch disables the internal sweep generator and permits the CH B input to provide horizontal deflection (X-Y operation).
15. **Sweep Time VARIABLE Control.** Fine sweep time adjustment. In the extreme clockwise (CAL) position the sweep time is calibrated.

SWEEP AND TRIGGERING CONTROLS (10-27)

10. **DELAY TIME Switch.** Range selector switch permits coarse selection of delay time for delayed sweep operation (this control has no effect unless one or more of the TRIG DELAY buttons is engaged ... INTEN, CH A DLY'D, or CH B DLY'D). Five ranges of 1 to 10 μ s, 10 to 100 μ s, 0.1 to 1 ms, 1 to 10 ms, and 10 to 100 ms.

16. **◀▶ POSITION Control.** Rotation adjusts horizontal position of trace (both traces in DUAL mode). Push-pull switch selects 5X magnification (PULL 5X MAG) when pulled out; normal when pushed in.
17. **HOLDOFF Control.** Rotation adjusts holdoff time (trigger inhibit period beyond sweep duration). Fully counterclockwise rotation is NORM, clockwise rotation increases holdoff period. Push-pull switch elects chop or alternate method of dual-trace generation; chop when pulled out (PULL CHOP), alternate when pushed in (except alternate method is always selected when SOURCE switch is in ALT position).
18. **LEVEL Control.** Trigger level adjustment determines point on waveform where sweep starts. Rotation in (-) direction selects more negative point of triggering, and rotation in (+) direction selects more positive point of triggering. Push-pull switch selects automatic triggering when pulled out (PULL AUTO). With automatic triggering, a sweep is generated automatically (free runs) in the absence of trigger signal; reverts to triggered sweep operation in the presence of adequate trigger signal.
19. **SLOPE Switch.** Two-position lever switch with the following positions:
 - (+) - Sweep is triggered on positive-going slope of waveform, or with positive sync pulse of composite video waveform.
 - (-) - Sweep is triggered on negative-going slope of waveform, or negative sync pulse of composite video waveform.
20. **FIX-NORM Button.** (Model 1530 only) In the FIX position (button engaged), the triggering level is automatically fixed at the center of the triggering waveform, regardless of the position of the LEVEL control. In the NORM position, (button released), variable triggering level is enabled.
21. **FRAME-LINE Button.** In the FRAME position (button engaged), vertical sync pulses of a composite video signal are selected for triggering. In the LINE position (button released), horizontal sync pulses of a composite video signal are selected for triggering. The LINE position is also used for all non-video waveforms.
22. **INTENSify Button.** When this button is engaged, the first portion of the trace(s) is of normal intensity, and the delayed sweep portion is brighter, or intensified. The beginning of the brighter portion identifies the starting point of delayed sweep. The delay time period is variable with the DELAY TIME controls (10 AND 11). Normal non-intensified trace when switch is OFF (button released).
23. **CH A DLY'D Button.** When this button is engaged, the beginning of the channel A trace is delayed by the period selected with the DELAY TIME controls. Normal non-delayed trace when switch is OFF (button released).
24. **CH B DYL'D Button.** When this button is engaged, the beginning of the channel B trace is delayed by the period selected with the DELAY TIME controls. Normal non-delayed trace when switch is OFF (button released).
25. **COUPLING Switch.** Four-position lever switch with the following positions:
 - AC - Trigger is ac coupled. 10 Hz to 30 MHz response.
 - LF Rej - Triggering below 10 kHz is attenuated.
 - HF Rej - Triggering above 100 kHz is attenuated.
 - DC - Trigger is dc coupled. DC to 30 MHz response.

- 26. SOURCE Switch.** Five-position lever switch selects triggering source for the sweep, with the following positions:

ALT -

In CH A and ADD mode, sweep is triggered by channel A signal.

In CH B mode, sweep is triggered by channel B signal.

Alternate triggering in DUAL mode; channel A trace is triggered by channel A signal and channel B trace is triggered by channel B signal. Scope operates in alternate sweep method regardless of sweep speed or setting of PULL CHOP switch.

CH A - Sweep is triggered by channel A signal regardless of MODE selection.

CH B - Sweep is triggered by channel B signal regardless of MODE selection.

LINE - Sweep is triggered by 50/60 Hz line voltage.

EXT - Sweep is triggered by signal applied to EXT TRIG jack.

- 27. EXT TRIG Jack.** Input terminal for external trigger signal.

CHANNEL B CONTROLS (28-33)

- 28. CH B POLARITY Button.** In the NORM position (button released), the channel B signal is non-inverted. In the INV position (button engaged), the channel B signal is inverted. In the ADD mode, and the CH B POLARITY switch in INV, the channel B signal is subtracted from the channel A signal and the difference is displayed as a single trace.

- 29. POSITION Control.** Rotation adjusts vertical position of channel B trace. In X-Y operation rotation adjusts horizontal position of display. Push-pull switch (PULL 5 ► 2 mV) selects channel B sensitivity when VOLTS/DIV switch is set to most sensitive range. Pull for 2 mV/div sensitivity, push for 5 mV/div sensitivity.

- 30. INPUT Jack.** Vertical input for channel B trace in normal sweep operation. External horizontal input in X-Y operation.

- 31. AC-GND-DC Switch.** Three-position lever switch which operates as follows:

AC - Blocks dc component of channel B input signal.

GND - Opens signal path and grounds input to vertical amplifier. This provides a zero-signal base line, the position of which can be used as a reference when performing dc measurements.

DC - Direct input of ac and dc component of channel B input signal.

- 32. VOLTS/DIV Switch.** Vertical attenuator for channel B; provides step adjustment of vertical sensitivity. When VARIABLE control (33) is set to CAL, vertical sensitivity is calibrated in 10 steps from 5 V/div to 5 mV/div (2 mV/div when POSITION control is pulled). In X-Y operation, this control provides step adjustment of horizontal sensitivity.

- 33. VARIABLE Control.** Rotation provides fine control of channel B vertical sensitivity. In the fully clockwise (CAL) position, the vertical attenuator is calibrated. In X-Y operation, this control becomes the fine horizontal gain control.

CHANNEL A CONTROLS (34-38)

34. VOLTS/DIV Switch. Vertical attenuator for channel A; provides step adjustment of vertical sensitivity. When VARIABLE control (35) is set to CAL, vertical sensitivity is calibrated in 10 steps from 5 V/div to 5 mV/div (2 mV/div when POSITION control is pulled).

35. VARIABLE Control. Rotation provides fine control of channel A vertical sensitivity. In the fully clockwise (CAL) position, the vertical attenuator is calibrated.

36. AC-GND-DC Switch. Three-position lever switch which operates as follows:

AC - Blocks dc component of channel A input signal.

GND - Opens signal path and grounds input to vertical amplifier. This provides a zero-signal base line, the position of which can be used as a reference when performing dc measurements.

DC - Direct input of ac and dc component of channel A input signal.

37. INPUT Jack. Vertical input for channel A trace. Vertical input for X-Y operation.

38. POSITION Control. Rotation adjusts vertical position of channel A trace. In X-Y operation rotation adjusts vertical position of display. Push-pull switch (PULL 5 ► 2 mV) selects channel A sensitivity when VOLT/DIV switch is set to most sensitive range. Pull for 2 mV/div sensitivity, push for 5 mV/div sensitivity.

ADDITIONAL FACILITIES (See Fig. 6)

39. Cord Wrap/Feet. Support oscilloscope in vertical position (face up) and serve as cord wrap for storing power cord.

40. Fuse Holder.

42. AC Power Cord.

43. VR108. CH B STEP ATT. BAL Control (under rubber plug). Screwdriver adjustment for channel B trace step attenuator balance.

44. VR106. CH B VARL. BAL Control (under rubber plug). Screwdriver adjustment for channel B trace vertical dc balance.

45. Combination Carrying Handle and Tilt Stand. When the handle is folded upward, the oscilloscope rests on rubber feet. When the handle is folded downward, it elevates the front of the oscilloscope to a convenient viewing angle. Press both pivot points to unlock and rotate the handle. Handle locks at each 22-1/2° angle of rotation.

46. VR103. CH A STEP ATT. BAL Control (under rubber plug). Screwdriver adjustment for channel A trace step attenuator balance.

47. VR101. CH A VARL. ATT. BAL control (under rubber plug). Screwdriver adjustment for channel A trace vertical dc balance.

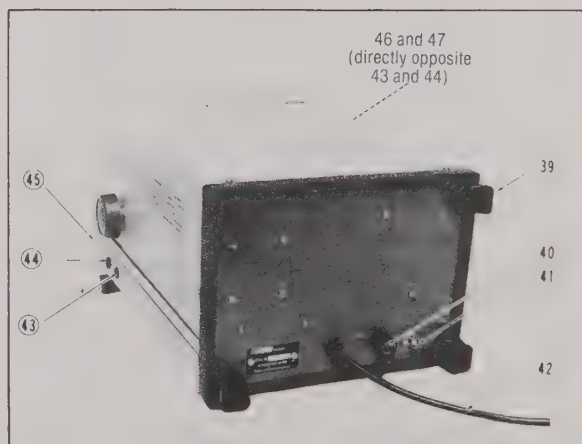


Fig. 6. Rear and Side Panel Facilities

CIRCUIT DESCRIPTION

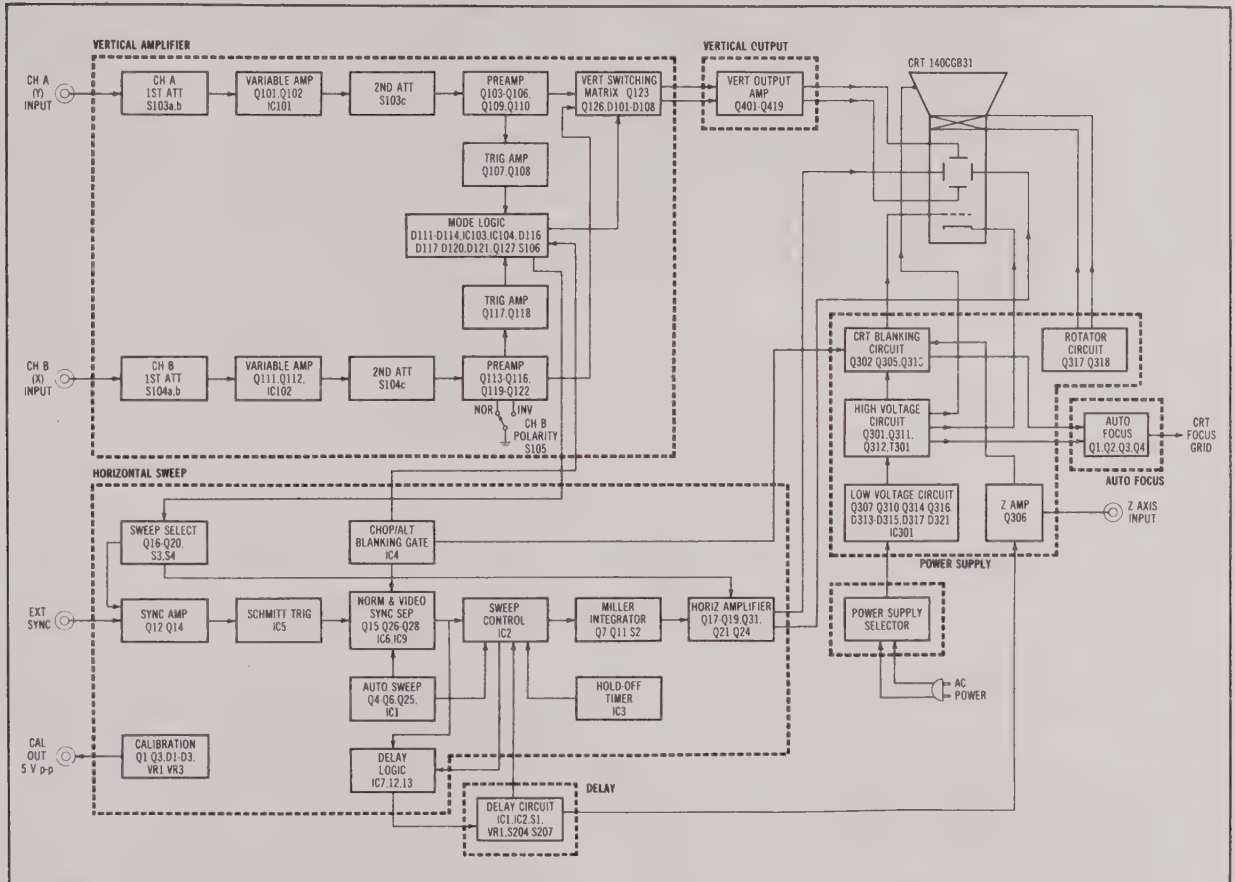


Fig. 7. Block Diagram of Complete Oscilloscope

GENERAL

Refer to the complete oscilloscope block diagram in Fig. 7. The Model 1530 and 1525 Dual-Trace Oscilloscopes provide identical attenuators and preamplifiers for channel A and channel B inputs. The outputs of the preamplifiers are applied to the vertical amplifier circuit after proper switching.

Selection of channel A or channel B signals for vertical deflection is accomplished by the vertical switching matrix. The mode switch and vertical mode logic circuit gates only the channel A signal in CH A mode and X-Y operation, only the channel B signal in CH B mode alternately gates each in the

DUAL mode, or simultaneously gates both in the ADD mode. The vertical input signal is then fed to the vertical output circuit and applied to the vertical deflection plates of the CRT.

The horizontal sweep circuit generates a sawtooth waveform synchronized by triggering signals from the vertical circuit or from an external source. The sawtooth waveforms drive the horizontal amplifier and are applied to the horizontal deflection plates of the CRT. During X-Y operation, the channel B vertical signal is amplified and applied as horizontal signal to the horizontal amplifier.

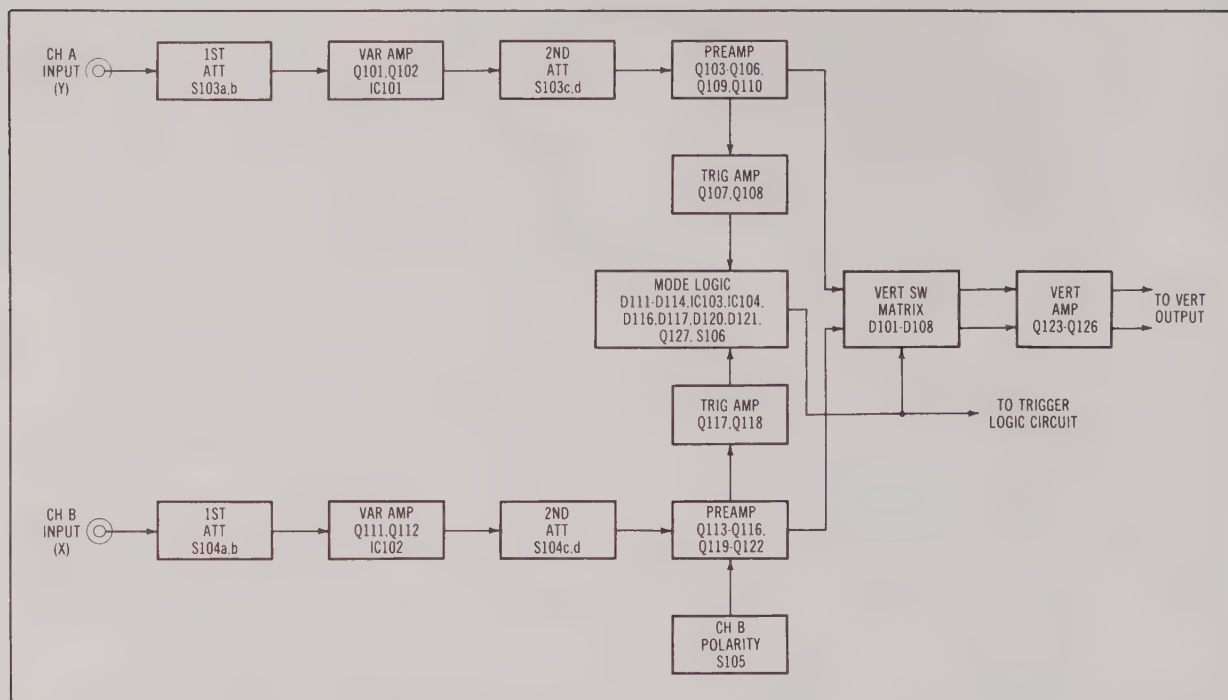


Fig. 8. Block Diagram, Vertical Preamplifier.

VERTICAL AMPLIFIER

(Refer to Fig. 8)

Channel A (Y) and channel B (X) preamplifiers are identical circuits and operate the same. Only channel A is described in the following description.

The vertical input signal from the input terminal is coupled to the first attenuator section directly or capacitively, as selected by the AC-GND-DC switch, S101. One section of the VOLTS/DIV switch, S103, provides ratios of 1:1, 10:1, 100:1, and 1000:1. After the first attenuator section, the signal is fed to a high impedance input stage of the vertical preamp consisting of a dual FET, Q102. The balanced configuration of this circuit provides excellent dc balance stability against temperature change and power supply fluctuations. Transistor Q101 and diode D122 protect Q102 from negative overvoltage. Positive overvoltage is clamped by Q102 itself.

The outputs of Q102 are applied to an

op-amp, IC101, whose output is fed to a second attenuator circuit controlled by the second section of the VOLTS/DIV switch, S103. The second attenuator provides ratios of 1:1, 2:1, and 5:1. Together, the first and second attenuator sections give an attenuation sequence of 1-2-5, with the appropriate exponent.

Transistors Q103-Q106, Q109, and Q110 further amplify the vertical signal before it reaches the vertical drive amplifiers, Q123-Q126. A sample of the vertical signal at the collectors of Q105 and Q106 is amplified by trigger amplifiers Q107 and Q108, and applied to the triggering circuits through the mode logic circuits.

The only difference between the channel A and channel B preamplifiers is that CH B POLARITY switch S105 reverses the polarity of the channel B signal when in the INV position. This is accomplished by switching on either transistor pair Q119/Q122 or Q120/-Q121 in the channel B preamplifier circuit.

MODE LOGIC

(Refer to Fig. 9)

The mode of operation, CH A, CH B, DUAL, ADD, is selected by the MODE switch, S106, and controlled by digital logic circuits IC103, IC104, and diodes D101-D108. When the CH A mode is selected, a low is placed at the set (S) input of IC104. The Q output is high and the $\bar{Q}$ output is low at this time. This reverse biases D101 and D104, which are connected to the collectors of the CH A pre-amplifiers. This allows the CH A vertical signal to be applied to vertical drive amplifiers Q123-Q126. Diodes D107 and D108 are forward biased by the low on the $\bar{Q}$ output of IC104, preventing the CH B signal from reaching vertical drive amplifiers Q123-Q126.

In the CH B mode, the reverse action occurs by applying a low to the reset (R) input of IC104. This causes the Q output of IC104 to go low and the $\bar{Q}$ output to go high, allowing the CH B vertical signal to be applied to vertical drive amplifiers Q123-Q126.

When the MODE selector is in the DUAL position, both channels are displayed. Below a sweep speed of 0.5 ms/division, or when the CHOP button is engaged, IC104 outputs are switched by a 200 kHz clock pulse (CP) applied to the clock input of IC104. In this state, the Q and $\bar{Q}$ outputs of IC104 change with each CP input. This action chops the trace into 5 μ s segments which are alternately switched between CH A and CH B to provide a dual trace. The clock pulse is generated by an oscillator on the sweep board and coupled to IC104.

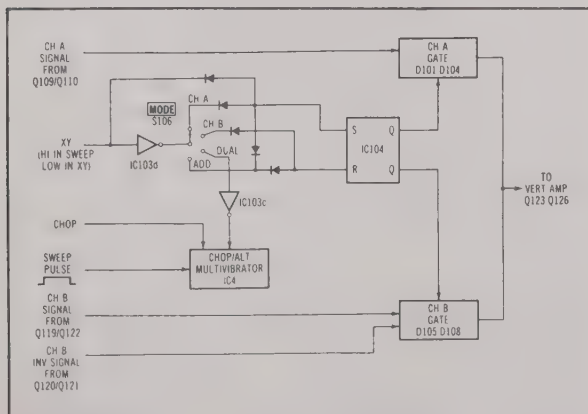


Fig. 9. Vertical Mode Logic Circuit Diagram.

For sweep speeds of 0.5 ms/division or faster, or when ALT triggering is selected, the Q and $\bar{Q}$ outputs of IC104 switch states after every sweep; therefore, CH A and CH B vertical signals alternate for display. Thus, CH A is viewed during one sweep and CH B is viewed during the next.

When the ADD mode is selected, both the set (S) and reset (R) inputs of IC104 are low and the Q and $\bar{Q}$ output are both high. The signals from both CH A and CH B are added algebraically and applied to vertical drive amplifiers Q123-Q126 via diodes D101, D102 (CH A) and D105, D106 (CH B).

VERTICAL OUTPUT AMPLIFIER

(Refer to Fig. 10)

The output signal from vertical drive amplifiers Q125 and Q126 is applied to the vertical output amplifiers consisting of two stages of differential amplifiers, Q401-Q404. These connect to two emitter followers, Q405 and Q406, which drive cascode amplifiers Q408-Q411. Four transistors, Q412, Q418, Q413, and Q419, provide current sources for cascode amplifiers Q408-Q411. The output of the cascode amplifiers is applied to the vertical deflection plates of the CRT.

To obtain the higher frequency response in Model 1530, some additional circuits are found. Negative feedback from the cascode amplifiers is applied to the base of Q405 and Q406 via FET inverters Q414 and Q415. Emitter followers Q416 and Q417 drive current source transistors Q418 and Q419 when extra current is required for fast signals.

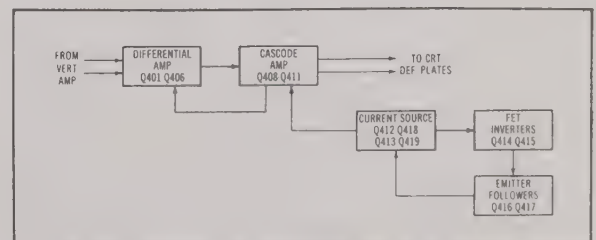


Fig. 10. Vertical Output Amp Block Diagram.

TRIGGER CIRCUIT

(Refer to Fig. 11)

The CH A vertical signal at the emitters of Q105 and Q106 is amplified by trigger amplifiers Q107 and Q108 and applied to Q127. The output of Q127 is used as a trigger source. The CH B signal from Q115 and Q116 is amplified by trigger amplifiers Q117 and Q118 and also applied to Q127. Digital logic circuits IC8 and IC103, and diodes D120 and D121, determine which signal shall be selected as the trigger source.

Trigger selection is primarily dependent upon the position of the SOURCE switch, S3. When the SOURCE switch is in the CH A position, the channel A signal becomes the trigger signal, regardless of the mode of operation. Likewise, when the SOURCE switch is in the CH B position, the channel B signal is always the trigger signal. In the EXT position, the signal applied at the EXT TRIG jack is the trigger signal. In the LINE position, a 50 or 60 Hz power line signal from the 14-volt secondary of the power transformer becomes the trigger signal. When the SOURCE switch is in the ALT position, trigger selection is secondarily dependent upon the position of MODE switch S106, and allows the trigger source to automatically follow the operating mode. With the SOURCE switch in ALT and the MODE switch in CH A or ADD modes, the channel A signal becomes the trigger signal; and when the SOURCE switch is in ALT and the MODE switch is in CH B, the channel B signal becomes the trigger. If the SOURCE switch is in ALT while the MODE switch is in DUAL, the channel A and channel B signals are alternately selected as triggers at the end of each sweep.

Whenever the channel A signal is to be the trigger signal, diode D120 is reverse biased and permits channel A trigger signal from Q108 to reach transistor Q127. Conversely, when D120 is forward biased, the channel A trigger signal is shunted to ground and does not reach Q127. Similarly, diode D121 permits the channel B trigger signal from Q118 to reach Q127 when reverse biased, or shunts the Q118 output to ground when forward biased.

Selection of the channel A or B trigger signal is controlled by IC103a and IC103b in response to the "Source" signal from IC8. When the "Source" signal is high, the output of

IC103b is low and D121 is forward biased to shunt the channel B signal; simultaneously, the output of IC103a is high and D120 is reverse biased and the channel A signal is allowed to reach Q127. The reverse action is also true.

When SOURCE switch S3 is in the CH B position, a ground is placed directly on the "Source" line. With S3 in the CH A position, IC8 latches the "Source" line high. When S3 is in the ALT position, IC8 is toggled by IC103 at the end of each sweep, causing the "Source" line to alternately go low and high. IC103, in turn, is toggled by the CP (clock pulse) input from the chop/alternate multivibrator, IC4, of the vertical mode logic circuit. A line from S3 to IC4 locks out chop operation when S3 is in the ALT position.

In X-Y operation, the $\overline{XY}$ signal is low. This low is applied through diode D119 to IC104, which selects the channel A signal for vertical deflection. The $\overline{XY}$ signal is also applied to IC103 which selects the channel B trigger signal via Q127 for horizontal deflection.

In normal sweep operation, the selected trigger signal output of Q127 is routed through amplifiers Q20 and Q16 on the sweep board. In X-Y operation, amplifier Q19 is enabled and the channel B trigger signal is applied via Q19 and Q31 to the horizontal output amplifiers.

The triggering signal is then routed to FET amplifier Q12 through COUPLING switch S4. The signal is direct coupled in the DC position, and capacitively coupled in the AC position. The signal is capacitively coupled through a low-pass filter in the HF REJ position and a high-pass filter in the LF REJ position.

For Model 1525 at all times, and for model 1530 when FIX-NORM pushbutton switch S203 in the NORM position (button released), the output of Q12 is directly coupled to emitter follower Q13, which drives one input (pin 2) of Schmitt trigger IC5. The TRIG LEVEL control, VR8, sets a DC reference level at the other input (pin 1) of IC5 through Q14. IC5 acts as a high-gain differential amplifier, or Schmitt trigger. When the signal on pin 2 exceeds the dc level on pin 1, the output of IC5 changes state and results in a sharp trigger. When the pin 2 level drops below the pin 1 level, a trigger signal of the opposite polarity is developed.

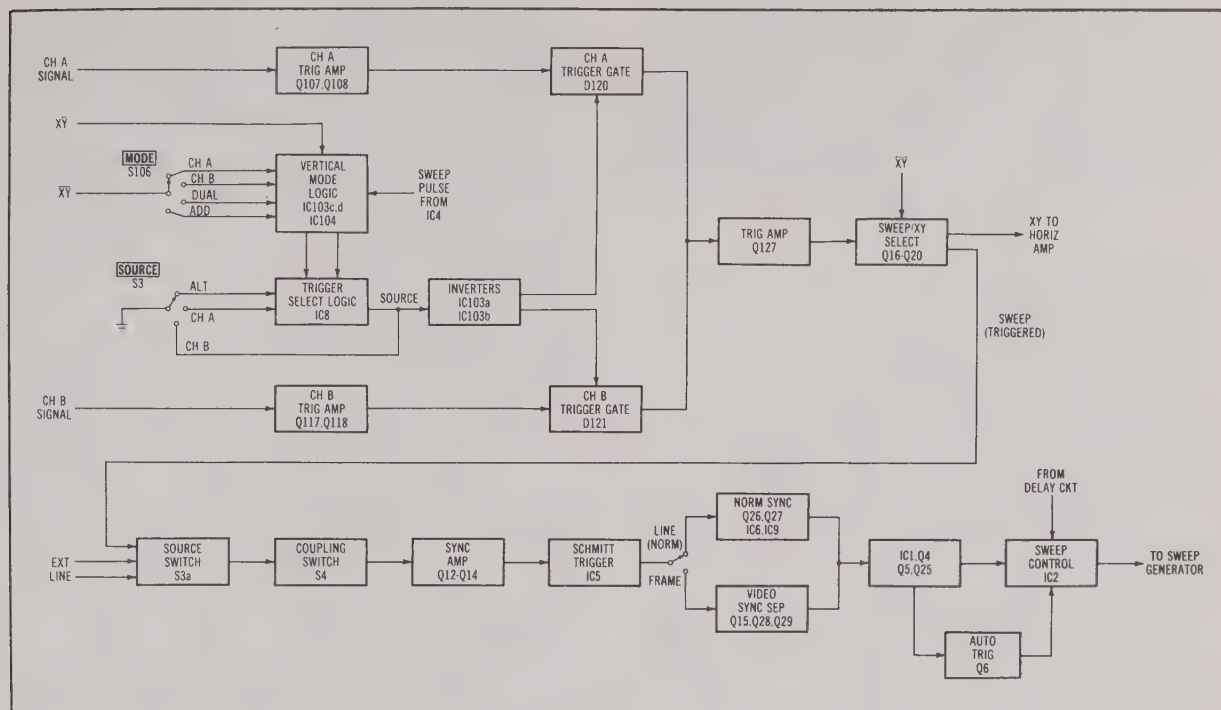


Fig. 11. Trigger Circuit Block Diagram.

When FIX-NORM switch S203 is in the FIX position, (Model 1530 only) the output of Q12 is capacitively coupled to Q13 and then to pin 2 of IC5. The dc reference voltage for pin 1 is developed by detecting and filtering the trigger input voltage at the input of Q14. This is used instead of the dc reference level from the TRIG LEVEL control, and establishes a threshold level for IC5 at the center of the waveform being used for triggering.

For both models, the positive and negative output signals of IC5 are applied to the normal sync gates of IC6 and IC9, through Q26 and Q27. When the SLOPE switch, S5, is in the positive (+) position, the Q26 signal is gated through IC6 and IC9. When SLOPE switch S5 is in the negative (-) position, the Q27 signal is gated through IC6 and IC9.

In Model 1530 only, when NORM-SINGLE-RESET switch S209 is in the SINGLE position, the input (pin 2) of IC3 goes high. In this condition, a clock pulse input must be applied to IC3 to cause its output (pin 3) to go high and enable the sweep control multivibrator, IC2. This is accomplished by placing the NORM-SINGLE-RESET switch, S209, in the RESET

position, which enables IC2 for one sweep only. The hold-off pulse at the end of the single sweep reverts IC3 to the standby condition (IC3 goes low), which remains in that state until switch S209 is again placed in the RESET position. The output of IC3 (pin 3) drives the READY LED which lights when S209 is in the RESET position, and stays on until the sweep is completed.

When FRAME-LINE pushbutton switch S204 is in the FRAME position (button depressed) it inhibits IC9 and allows the video sync circuits, Q15, Q28, and Q29, to supply the sweep triggering signal. The polarity of the signal from IC5 is selected by the SLOPE switch, S5, and applied to Q15, Q28, and Q29. Capacitor C65, in the coupling circuit between Q28 and Q29, shunts the short duration horizontal sync pulses and allows the longer duration vertical sync pulses to reach Q29. This action separates horizontal and vertical sync pulses to allow viewing of vertical frames of fields of video.

The trigger pulse at the output of IC9 is connected to the K input of sweep control multivibrator IC2 through IC1, Q4, Q5, and

CIRCUIT DESCRIPTION

Q25. This signal synchronizes the sweep to the waveform being used as the trigger source. In the absence of triggering, no sweep is normally developed; however, pulling out the PULL AUTO switch enables Q6, and multi-vibrator IC2 will run freely, providing horizontal sweep.

HORIZONTAL SWEEP

(Refer to Fig. 12)

Horizontal deflection is produced by the horizontal preamplifiers and horizontal output amplifiers. In all except X-Y operation, the input to the horizontal preamplifiers is furnished by the calibrated sweep speed circuits, consisting of the sweep control circuit (IC2), Miller integrator Q10 and Q11, and hold-off timer IC3. The sweep can be synchronized by the CH A or CH B input signal, or by an external trigger signal. In the absence of a synchronizing trigger signal, the automatic sweep circuit, Q4, Q5, Q6, Q25, and IC1, can start the sweep. When X-Y operation is selected, the CH B signal is coupled to the horizontal amplifiers for horizontal deflection and the sweep circuits are disabled.

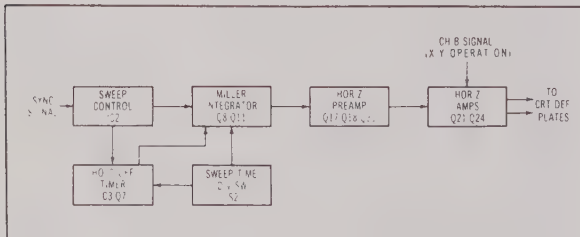


Fig. 12. Horizontal Sweep Block Diagram.

When a trigger pulse appears at the reset (R) input of IC2, the Q output goes low allowing the sweep ramp integrator circuit, Q10 and Q11, to begin sweep. Sweep speed is determined by the RC time constants set by the SWEEP TIME/DIV switch, S2. The output of the integrator, a decreasing linear ramp, is fed through transistors Q8 and Q9 to the horizontal amplifier stages, Q17-Q24, and Q31. The outputs of Q23 and Q24 are connected to the horizontal deflection plates of the CRT.

An increasing linear ramp signal from the integrator circuit is fed to the threshold input of sweep hold-off timer, pin 6 of IC3. When

the decreasing ramp voltage has swept the scope trace to the right-hand limit of the sweep cycle, the corresponding increasing ramp voltage is fed to pin 6 of IC3. This causes pin 3 of IC3 and set (S) input of IC2 to go low, setting the Q output of IC2 to high and turning on transistor Q7. This discharges the integrating capacitor and resets the sweep back to the left-hand sweep limit. At the same time as the Q output of IC2 goes high, the $\bar{Q}$ output goes low and sends a high out the blanking control gate, pin 11 of IC4. This turns the trace intensity down so you cannot see the retrace as the electron beam is returned to the left-hand side of the CRT.

At the time the threshold setting of IC3 was reached, pin 3 low, the sweep hold-off capacitor connected to pin 2 of IC3 discharges through the HOLD OFF control, VR207. When the capacitor has discharged to less than 1.6 volts, pin 3 of IC3 is triggered high. This readies IC2 for the next trigger pulse, coming from either the clock input (pin 12) or from the reset (R) input when Q25 of the automatic triggering circuit is turned on. Pin 7 of IC3 also goes high and allows the hold-off capacitor to charge up again. The length of sweep hold-off is determined by the capacitor and the optimum value for each sweep speed automatically selected by the SWEEP TIME/DIV control.

During X-Y operation, the SWEEP TIME/DIV switch is set to the CH B position. The XY signal is then applied to disable sweep amplifiers Q18 and Q17, and enable XY amplifier Q19. The CH B trigger amplifier output is fed to the horizontal amplifiers via Q19 and Q31. In this mode, the CH B signal controls the horizontal position of the CRT trace.

DELAYED TRIGGERING

(Refer to Fig. 13)

The purpose of the delay circuit is to allow a variable delay period to be inserted between the occurrence of the trigger and the beginning of the sweep. The delay may be individually inserted before the channel A sweep or channel B sweep, if desired, with the CH A DLY'D and CH B DLY'D pushbutton switches. With neither delay selected, normal non-delayed triggering is available. The non-calibrated delay period can be displayed on the

CRT and quite accurately adjusted by using the intensify feature. Pressing the INTEN switch causes the delay period to be displayed at normal intensity, and the balance of the trace to be intensified (brighter).

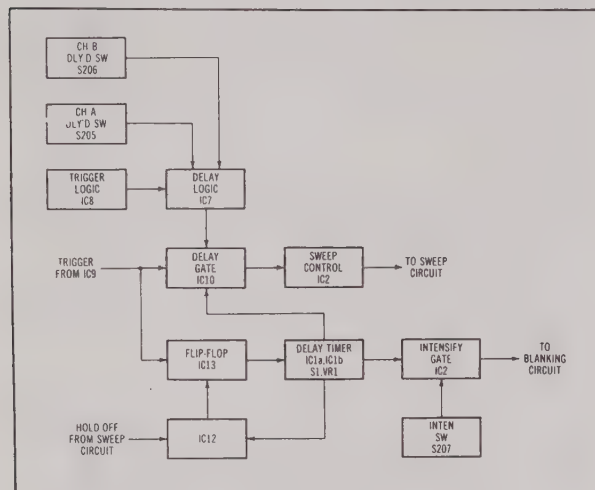


Fig. 13. Delay Circuit Block Diagram.

In normal non-delayed operation, delay gate IC10 is enabled so that the trigger from IC9 is coupled to sweep control IC2 without delay. When CH A DLY'D switch S205 is pressed, delay logic IC7 sets up IC10 so that the delay period occurs before the channel A trigger is coupled to IC2. Similarly, when CH B DLY'D switch S206 is pressed, IC7 sets up IC10 so that the delay period occurs before the channel B trigger is coupled to IC10. Inputs to IC7 from IC8 synchronize the delay to channel A or channel B.

The trigger that is applied to IC10 is simultaneously applied to flip-flop IC13. Flip-flop IC13 is enabled by IC12 at the end of hold-off period. The trigger causes IC13 to change states and start the delay timer. The delay timer consists of IC1a and IC1b, RC time constant components C1-C6, R5, R6, DELAY TIME switch S1, and VARIABLE control VR1. At the end of the delay period, IC1a changes states, which causes IC10 to trigger IC2. During hold-off, feedback to IC12 keeps IC13 disabled and the delay timer is reset.

The delay pulse from IC1a is also applied to intensify gate IC2. When selected by INTEN switch S207, an output pulse from IC2

(which begins at the end of the delay period) is applied to the blanking circuits. This pulse is superimposed on the blanking pulse as intensity modulation; the delay period is of normal intensity, and the balance of the trace is intensified. The end of sweep (beginning of hold-off) also ends the intensify pulse via IC12 and IC13.

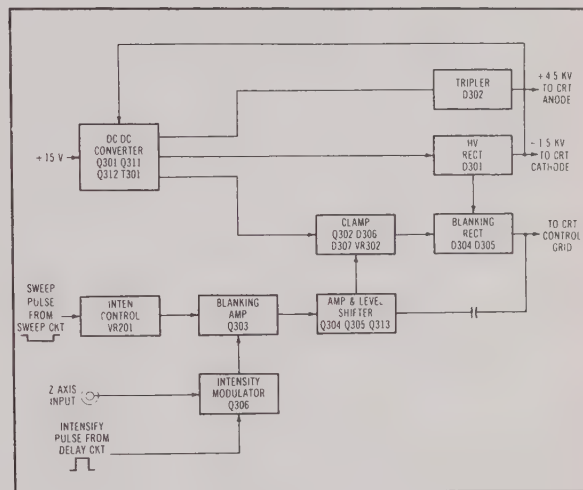


Fig. 14. Blanking, Intensity, and High Voltage Power Supply Block Diagram.

HIGH VOLTAGE POWER SUPPLY (Refer to Fig. 14)

The unregulated +15 volt power supply drives a dc-to-dc converter circuit consisting of Q301, Q311, Q312, and T301. Transformer and transistor Q301 form an oscillator which operates at approximately 20 kHz. A high voltage 20 kHz ac is thus developed across the secondary of T301. The secondary voltage of transformer T301 is rectified by D301 and filtered as -1.5 kV for the cathode of the CRT. Regulation is achieved by feedback of the -1.5 kV across a voltage divider to Q311 and Q312. VR303 adjusts the high voltage. The -1.5 kV is also applied across the FOCUS control, VR205. The output of VR205 is summed with the output of the auto focus circuit and applied to the focus grid of the CRT. A tapped portion of the high voltage secondary of T301 is applied to the blanking and intensity

control circuits (see Fig. 15 and associated circuit description). The secondary voltage of T301 is also applied to rectifier/voltage tripler D302, which provides +4.5 kV to the anode of the CRT. Filament voltage for the CRT is provided by a separate low-voltage secondary of T301, which is floated at cathode potential.

BLANKING AND INTENSITY CONTROL

(Refer to Fig. 15)

This circuit blanks the CRT during the retrace period (when electron beam returns from right side to left side of CRT) and unblanks the CRT during sweep. This is accomplished by setting the instantaneous dc voltage on the intensity grid (pin 3) of the CRT.

The total acceleration potential for the CRT electron beam is 6 kV, the sum of the +4.5 kV anode voltage and the -1.5 kV cathode voltage. Beam current is controlled by the voltage on the intensity grid with respect to the cathode. In the quiescent state with no sweep, the intensity grid is roughly -85 volts negative in respect to the cathode. Variation above or below is regulated by setting the INTENSITY THRESHOLD adjustment VR201. This control establishes the dc reference level in the unblanking circuit. The potential difference between the intensity grid and the cathode is developed by transformer T301, transistor switch Q302, coupling capacitor C308 and rectifier diodes D304, D304.

Part of the switching voltage of the dc-to-dc converter transformer T301 drives transistor switch Q302. The voltage divider components in the Q302 circuit determine the conduction and cutoff limits. That portion of the transformer switching voltage within these limits is capacitively coupled through C308 which re-references the alternating voltage to the CRT cathode voltage. Diodes D304 and D305 are blanking rectifiers. Diode D304 clamps the positive most swing of the 20 kHz switching voltage to the reference voltage and diode D305 rectifies the switching voltage into the blanking voltage to the intensity grid.

During the sweep, a positive going unblanking pulse is dc coupled to Q302, changing its conduction level. A lower amplitude 20 kHz switching voltage is applied to the blanking rectifier. This pulse reduces the bias on the CRT, which permits electron beam current

and unblanks the trace during the sweep. The unblanking pulse is also coupled through C307 for unblanking at higher speeds.

The unblanking pulse is developed from the sweep pulse from IC4, pin 11 on the sweep board. INTENSITY control VR201 controls the amplitude of the pulse which is then applied to the base of transistor Q303. Transistors Q303-Q304 and Q313 provide amplification and dc level shifting up to 45 volts in amplitude.

Intensity modulation from an external signal at the Z-AXIS INPUT jack is superimposed on the blanking signal by Q306.

In INTENSsify mode, the delay time pulse from IC2 is also superimposed on the blanking pulse by Q306.

A regulated +10 V and -10 V is applied across emitter followers Q317 and Q318. This permits TRACE ROTATION control VR206 to adjust emitter voltage through the +10 V to -10 V range. A dc current, variable in magnitude and of either polarity, is applied through the trace rotation coil around the CRT. The resultant magnetic field rotates the electron beam of the CRT to electrically adjust trace tilt.

AUTO FOCUS CIRCUIT

(Refer to Fig. 15)

The auto focus circuit was added as a product improvement to Model 1530, effective with serial number 07-04651, and is included in all Model 1525 oscilloscopes.

The operation of the auto focus circuit is very similar to that of the blanking and intensity circuit. Focus is controlled by the voltage on the focus grid, primarily with respect to the potential of the intensity grid. The auto focus circuit automatically controls the focus grid voltage so that it follows the intensity grid voltage. Thus, the potential difference between the two CRT grids is nearly constant, and optimum focus is automatically provided, even during the intensified portion of the sweep.

FOCUS control VR205 sets the dc reference voltage of the focus circuit. A boost voltage is developed by T301, Q4, C5, and rectifier diodes D4, D5. The amplitude of this boost voltage is modulated by the blanking

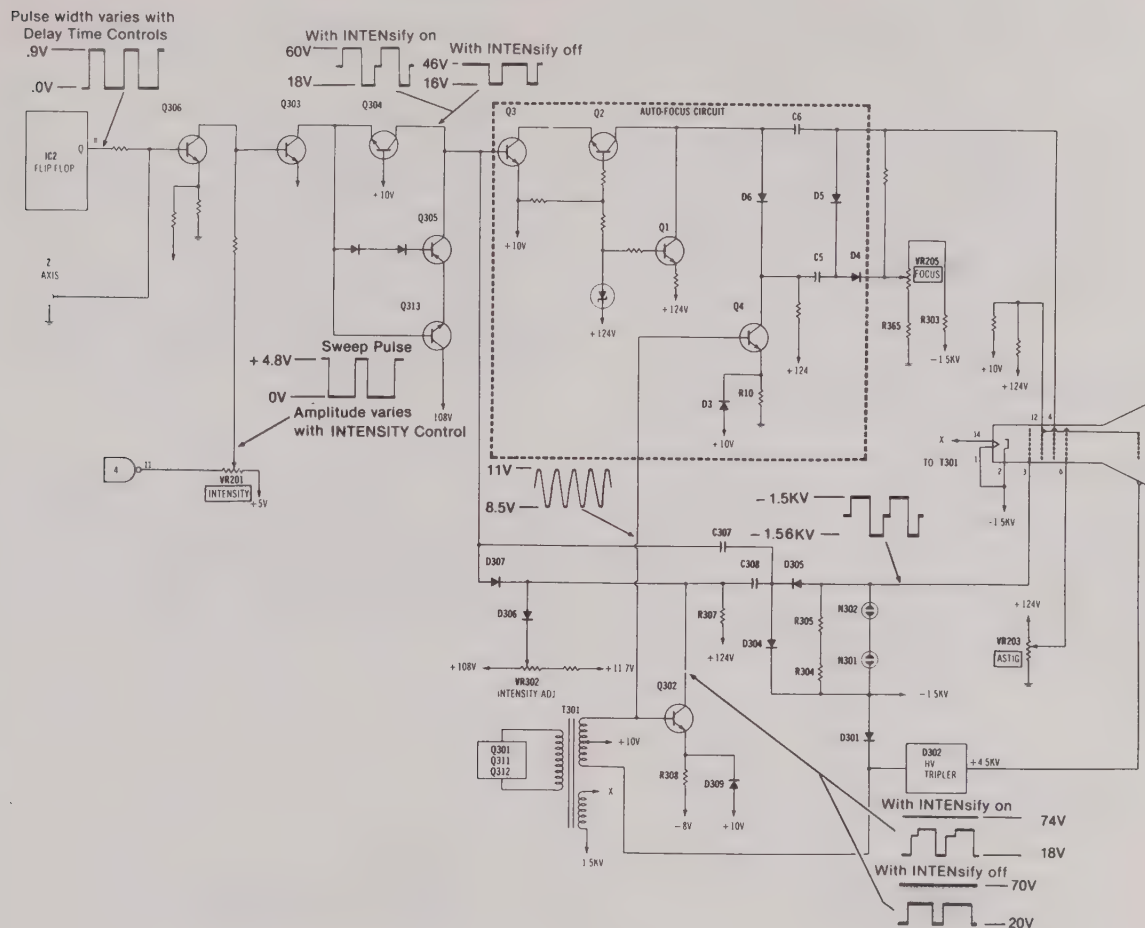


Fig. 15. Simplified Schematic of Unblanking and Intensity Circuit.

pulse, including any superimposed delay time pulse in the INTENSify mode. During the sweep, the same unblanking pulse is applied to the auto focus circuit (Q3) as is applied to the blanking circuit. This includes the superimposed delay time pulse in INTENSify mode. Inversion and dc level shifting are controlled by Q2, Q1, and D1.

Part of the switching voltage from the dc-to-dc converter (T301) drives Q4. Conduction and cutoff limits are set by the Q4 circuit voltage dividers. This voltage is capacitively coupled (C5) to the blanking rectifiers. D4 clamps the positive swing and D5 rectifies the voltage to the focus reference voltage. The pulse is rectified and summed with the focus reference voltage.

CALIBRATING VOLTAGE

Multivibrator circuit Q2 and Q3 on the sweep board generate a 1 kHz square wave. Variable resistors VR2 and VR3 are used to adjust the frequency (pulse width) of the positive and negative portions, respectively. The output is developed across amplifier Q1. Variable resistor VR1 adjusts the output level to 0.5 volts peak-to-peak.

LOW VOLTAGE POWER SUPPLY (Refer to Fig. 16)

The power supply voltages are fully regulated. The -8 volt output is adjusted by VR304. This voltage is used as reference in all the regulators; thus, all the other low voltages are also adjusted.

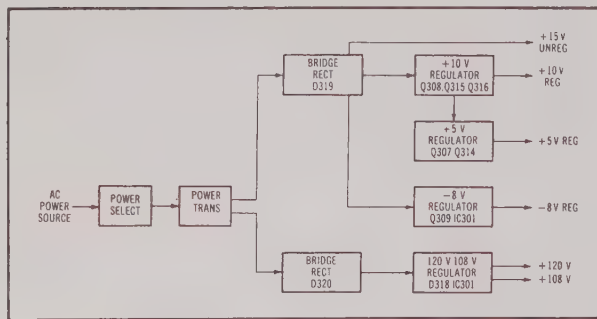


Fig. 16. Low Voltage Power Supply Block Diagram.

+15 Volt Supply

The 14-volt ac secondary winding of power transformer T1 is rectified in the positive polarity by diode bridge D319 to provide an unregulated +15 volts. This is also the source for the +10 volt, +5 volt, and high-voltage supplies.

+10 Volt Supply

The +15 volt supply is regulated to +10 volts by Q308, Q315, and Q316.

+5 Volt Supply

The regulated +10-volt output is regulated to +5 volts by Q307 and Q314.

-8 Volt Supply

The 14-volt ac winding of power transformer T1 is rectified in the negative polarity by diode bridge D320 and regulated to -8 volts by IC301a and Q309.

+124 Volt and +108 Volt Supply

The 120-volt secondary of power transformer T1 is rectified by diode bridge D320 and regulated by IC301b and Q310 to +120 volts dc. Zener diode D318 drops part of the power supply output to a regulated +108 volts dc.

OPERATOR MAINTENANCE

WARNING

To prevent electric shock, do not perform servicing that requires removal of the covers unless you are qualified to do so. Exposed high voltage, up to 6,000 volts is present when covers are removed. The following procedures do not require removal of the top or bottom cover.

FUSE REPLACEMENT

Fuse F1 is in series with the primary of the power transformer. If this fuse blows, the pilot light will go out and the oscilloscope will not operate. The fuse should not normally open unless a problem has developed in the unit. Try to determine and correct the cause of the blown fuse, then replace only with a fast blow fuse of the proper current rating; 0.6 amp for 120 VAC operation or 0.3 amp for 240 VAC operation. The fuse is located on the rear panel (see Fig. 5). A second internal fuse (F2) is in series with the high voltage power supply. If fuse F2 is open the power lamp will light but no trace is obtained. Replacing F2 is covered in the DISASSEMBLY section.

PERIODIC ADJUSTMENTS

The following operator adjustments only need to be checked and adjusted occasionally. The ASTIG and TRACE ROTATION controls are accessible from the front panel and are adjustable with a flat blade screwdriver. The dc balance adjustments are accessible from the sides of the oscilloscope without removing the bottom case and are adjustable with a very small flat blade screwdriver. The locations of these adjustments are shown in Fig. 4 and 5.

Trace Rotation

Strong magnetic fields, present in many locations where an oscilloscope may be used, may cause the trace to be tilted. The degree of tilt may vary as the scope is moved from

one location to another. The tilt should be adjusted so the trace is parallel with the horizontal lines on the graticule scale.

1. Set oscilloscope controls to produce a horizontal trace with no input signal (PULL AUTO position of triggering LEVEL switch).
2. Use POSITION controls as required to position the trace along a horizontal line of the graticule scale.
3. Adjust TRACE ROTATION so trace is parallel with the reference line on the graticule scale.

Astigmatism

1. Set SWEEP TIME/DIV switch to CH B position and channel A and channel B AC-GND-DC switches to GND position. This will produce a spot on the screen.
2. With INTENSITY control set about mid-range, adjust both the ASTIG and FOCUS controls for the sharpest, roundest spot. Do not readjust ASTIG control after this step.

CAUTION

Never allow a small spot of high brilliance to remain stationary on the screen for more than a few seconds. The screen may be permanently burned.

DC Balance

1. Set scope controls for a single horizontal trace on channel A with the channel A AC-GND-DC switch set to GND position.
2. Rotate the Channel A VARIABLE control from maximum clockwise to maximum counterclockwise, while observing the trace.
3. If the trace moves vertically, adjust VR101 (VARI. ATT. BAL.) for minimum or zero movement when performing step 2.

4. Rotate Channel A VOLTS/DIV switch through the 5 mV, 10mV, and 20mV positions while observing the trace.
5. If the trace moves vertically, adjust VR103 (STEP ATT. BAL.) for minimum or zero vertical movement when performing step 4.
6. Repeat the entire procedure for Channel B, adjusting VR106 for VARIABLE balance and VR108 for VOLTS/DIV step balance.

Probe Compensation

Probe compensation adjustment matches the probe to the input of the scope. For best results, compensation of both probes should be adjusted initially, then the same probe always used with channel A and channel B respectively. Probe compensation should be readjusted whenever a probe from a different oscilloscope is used, or the channel A and B probes are interchanged.

1. Connect probes to both INPUT jacks. Connect ground clip of probes of oscilloscope ground terminal and touch tips of both probes to CAL 1 kHz 0.5 V p-p terminal.
2. Select single trace operation of channel A, then channel B, for steps 3 and 4.
3. Set oscilloscope controls to display 3 or 4 cycles of CAL square wave at 5 or 6 divisions amplitude.
4. Adjust compensation trimmer on probe for optimum square wave waveshape (minimum overshoot, rounding off, and tilt).

CALIBRATION CHECK

A general check of calibration accuracy may be made by displaying the output of the CAL 1 kHz  0.5 V p-p terminal on the screen. This test signal has been factory adjusted to provide a square wave of 0.5 volt peak-to-peak amplitude and 1 millisecond time duration per cycle.

At .1 V/div this should produce five divisions of vertical deflection on channel A or channel B, or five divisions of horizontal deflection in X-Y operation when the VARIABLE controls are set to CAL. The 10 mV/div range may be used to check the 10:1 attenuation of the probe; five divisions or deflection should result.

With a .1 ms/div sweep time and VARIABLE set to CAL, one cycle of the waveform should occupy 10 divisions. At 1 ms/div sweep time, 10 cycles should span the 10 divisions, while 2 cycles should cover the 10 divisions using 5X magnification.

DISASSEMBLY

WARNING

High voltages, up to 6000 VDC, are present on the CRT and power supply board when the oscilloscope is operating. Before removing the case, be sure to turn off the power. The CRT may retain a high voltage charge long after the scope is turned off. Discharge high voltage points with a grounded probe after the case has been removed.

REMOVING THE CASE

The case is removed in two sections as shown in Fig. 17. The top section can be lifted off after removing seven Phillips head screws from the top and sides of the case. The bottom section can be lifted off after removing four Phillips head screws from the bottom of the case.

FUSE REPLACEMENT

The high voltage power supply fuse (F2) is located on the power supply board in series with the primary of the transformer. It is recommended the reason for the open fuse be determined before the fuse is replaced. Remove and replace the fuse (0.5 amp).

CRT REPLACEMENT

Refer to the accompanying exploded view of the oscilloscope. See Fig. 18.

1. Remove the case.
2. Remove CRT bezel.
3. Remove the two screws that clamp the CRT band over the neck of the CRT shield.
4. Remove the four screws that hold the CRT bracket to the front panel. Then, remove the one screw that attaches a black lead to the leg of the CRT band.

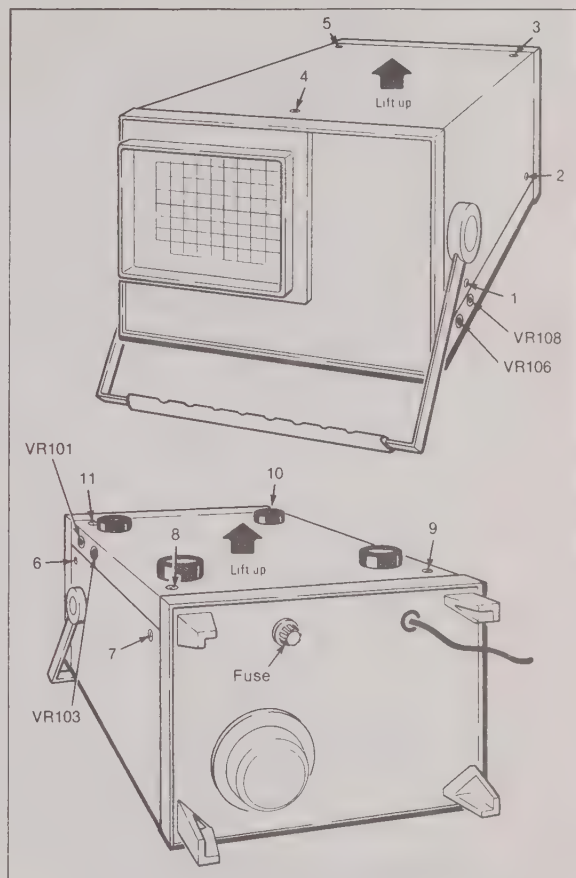


Fig. 17. Removing the Case.

5. Loosen the screw holding the CRT band to the rear panel.
6. Unplug the CRT from the CRT socket.
7. Remove the anode cap from the CRT.
8. Lift the CRT and slide the CRT shield backward to remove from the CRT and slide the CRT backward to remove from CRT bracket. Remove the tape holding the rotator coil. Slide the rotator coil over the neck of the CRT.
9. The CRT may now be replaced by reversing the steps of the above procedure. After replacement, readjust the TRACE ROTATION and ASTIG controls and recalibrate vertical gain, width, and frequency compensation adjustments.

CIRCUIT BOARD REMOVAL

Refer to the accompanying exploded views of the oscilloscope, Fig. 19 and 20.

Vertical Amplifier Board

1. Remove the top and bottom case and bezel.
2. Remove the decorative panel as follows:
 - a. Remove VOLTS/DIV and VARIABLE knobs (both CH A and CH B).
 - b. Remove SWEEP TIME/DIV, DELAY TIME and VARIABLE knobs.
 - c. Remove the POSITION knobs (both CH A and CH B).
 - d. Remove the SLOPE, COUPLING and SOURCE lever knobs.
 - e. Remove the TRIG. LEVEL knob.
 - f. Remove the POSITION, HOLD-OFF, FOCUS, and POWER/INTENSITY knobs.
 - g. Remove MODE and AC-GND-DC (both CH A and CH B) lever knobs.
 - h. Remove slotted hex lock nuts from shaft of VOLTS/DIV (both CH A and CH B), POSITION (both CH A and CH B), TRIG. LEVEL, DELAY TIME and POSITION controls.
3. Remove two screws securing each lever switch to the diecast panel.
4. Unsolder two resistors (R203, R204) from the BNC receptacle.
5. Remove the two screws from the board mounting hardware that hold the vertical amplifier board.
6. Remove one screw from the rear of the horizontal sweep board and remove the board mounting hardware.
7. Disconnect J1 by pulling the horizontal sweep board to the side.
8. Remove the vertical amplifier board by pulling the rear of the board away from the scope, the slide from the front panel. Disconnect P4.

Horizontal Sweep Board

1. Remove the case and decorative panel (this is the same procedure as step 1 and 2 of "vertical amplifier board" removal).
2. Remove two screws securing each of the SLOPE, COUPLING and SOURCE lever switches to the die-cast panel.
3. Remove slotted hex lock nuts from the shaft of SWEEP TIME/DIV and HOLD-OFF controls.
4. Disconnect the connectors from the terminals (1-8, 10-12, and 16).
5. Remove one screw which holds the horizontal sweep board to its mounting hardware.
6. Carefully disconnect and remove J1 and J2, which connect to the vertical amplifier board and power supply board.
7. Unplug P1 thru P8 from the horizontal sweep board.

Vertical Final Amplifier Board

1. Remove the cases.
2. Unsolder two yellow leads connecting CRT socket.
3. Remove two screws that secure vertical final amplifier board to rear panel.
4. Carefully disconnect and remove connectors J401 and J402, which connect vertical amplifier and power supply boards.

Power Supply Board

1. Disconnect P301, P302, P304, P305, P308, P309, and terminals 1, 2, and 3.
2. Remove the four board mounting screws, and carefully remove the board while disconnecting J402 and J2.

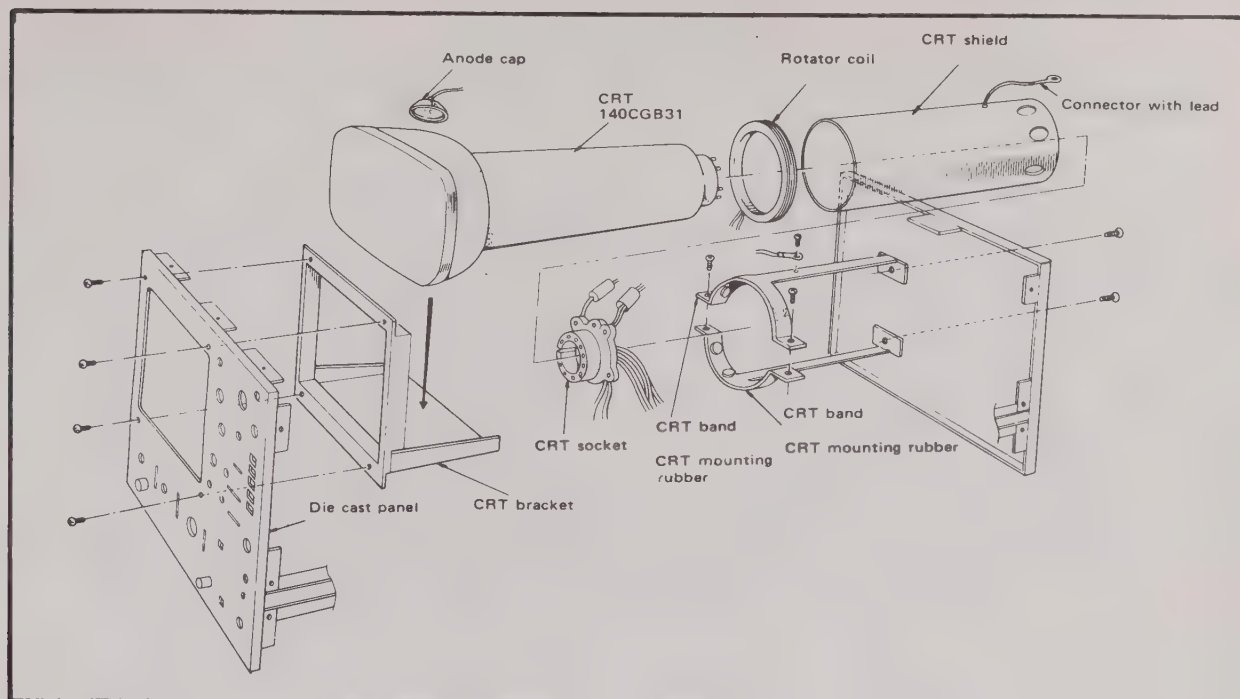


Fig. 18. Removing the CRT.

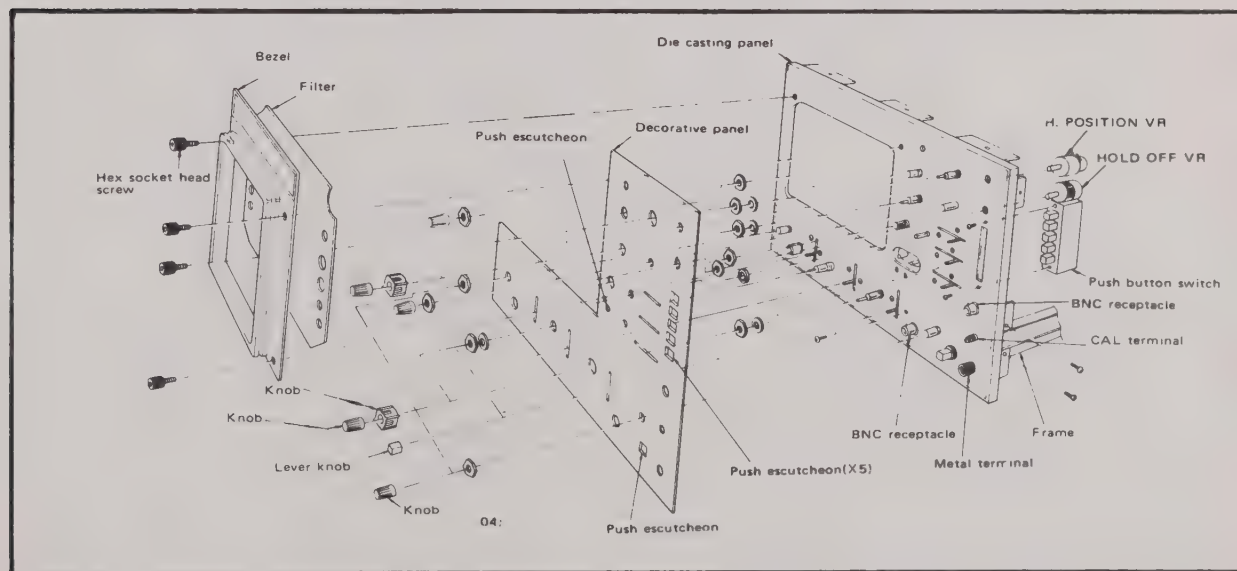


Fig. 19. Pictorial View of Front Panel.

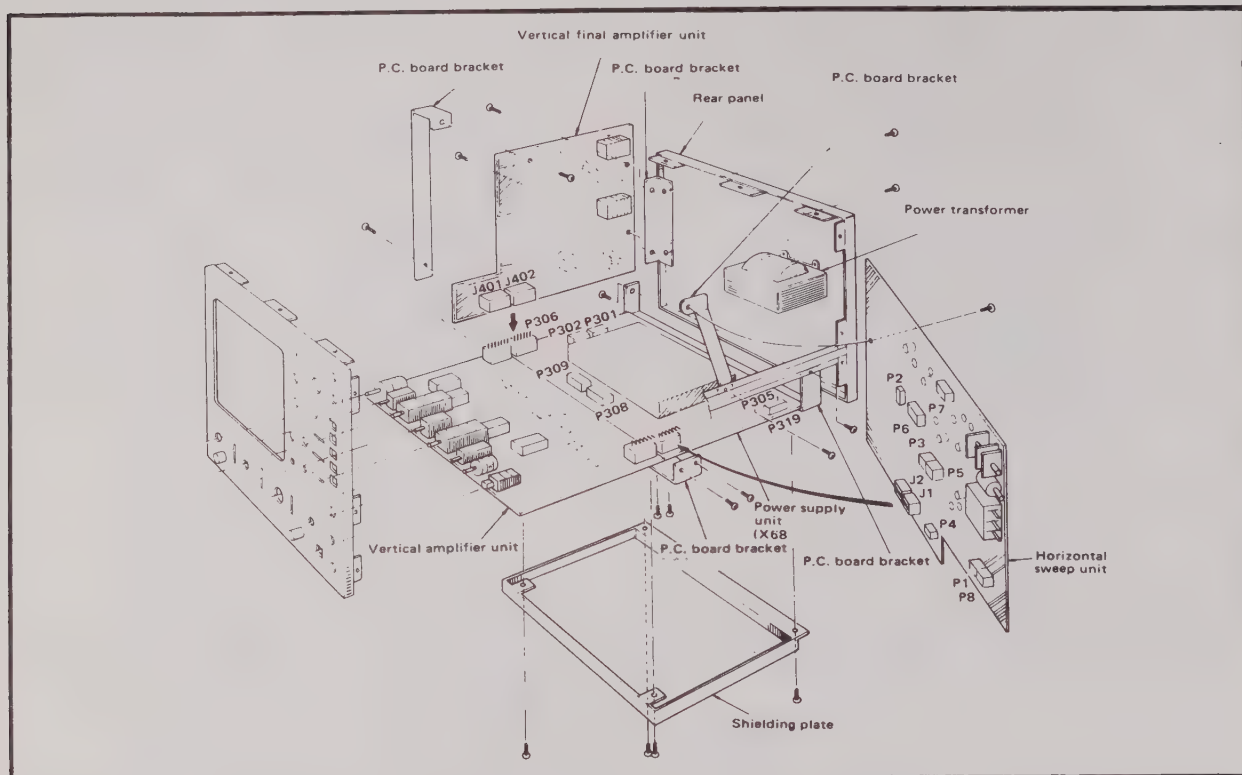


Fig. 20. Pictorial View of P.C. Board Assembly.

120/240 VAC CONVERSION

As shipped, this oscilloscope is set up for operation from 120 volt, 50/60 Hz ac power. It may be operated from 240 volt, 50/60 Hz power by inverting a power selector plug.

1. Remove the top case (Fig. 17).
2. Remove voltage selector plug P5, which is located on the inside of the chassis wall (below the power transformer), as shown in Fig. 21.
3. Rotate plug P5 180° and reinsert it.
4. Replace the 0.6 amp primary line fuse used for 120-volt operation or a 0.3 amp

fuse for 240-volt operation. The fuse is located on the rear panel.

5. Apply the AC 220/240 V, 50/60 Hz label on the rear panel, directly over the AC 110-120 V, 50/60 Hz label adjacent to the power cord entrance.

The power transformer may also be wired for operation from a nominal 100 VAC or 220 VAC, 50/60 Hz power source. Refer to the schematic diagram and make corresponding wiring changes at connector P3, which is adjacent to voltage selector plug P5. Use the 0.6 amp fuse for 100-volt operation or 0.3 amp fuse for 220-volt operation.

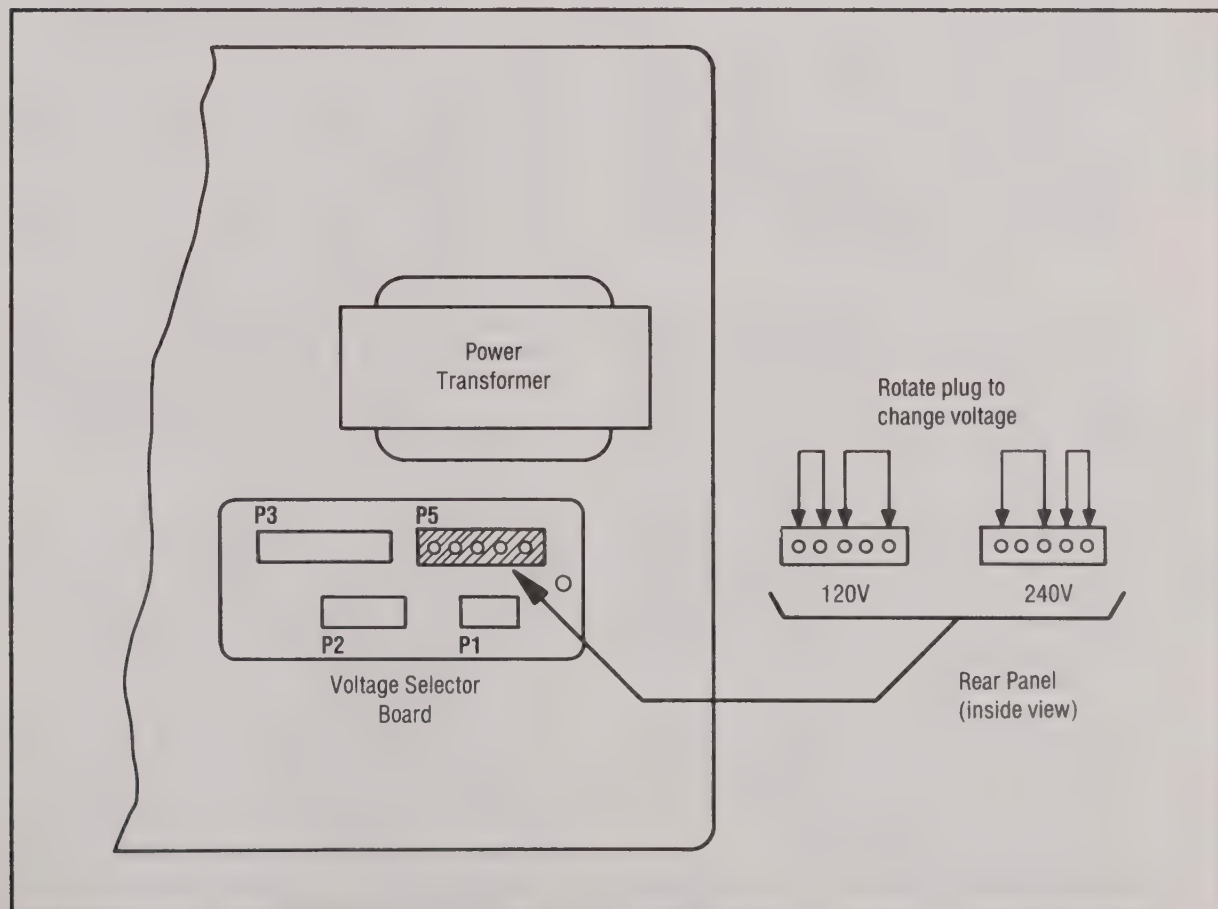


Fig. 21. AC Line Voltage Selection.

PERFORMANCE TESTS

OPERATIONAL TESTS

1. Connect the 1530 or 1525 oscilloscope to the proper power source. Test channel A and channel B independently.
2. Turn the power on by turning the INTENSITY control clockwise. The POWER light should come on.
3. Set the SWEEP TIME/DIV switch to the CH B position (X-Y operation). Adjust the INTENSITY control until a spot appears on the screen. Adjust the vertical and horizontal POSITION controls if necessary.
4. Adjust the INTENSITY and FOCUS controls for a thin, sharp dot.
5. Set the SWEEP TIME/DIV switch to the .1 ms position.
6. Set the CH A and CH B AC-GND-DC switch to the GND position (and the NORM-SINGLE-RESET switch to the NORM position for 1530 only).
7. Select automatic sweep by pulling outward on the triggering LEVEL control (PULL AUTO). A single trace should appear on the screen. If no trace appears, increase the INTENSITY control until a trace is easily observed.
8. Set the MODE switch to the DUAL position. Two traces should appear. Adjust the POSITION controls, if necessary, to position the traces for convenient viewing. The channel A trace should be above the channel B trace with both traces starting at the left edge of the graticule scale.
9. Check for proper adjustments of the TRACE ROTATION, ASTIG, and DC BALANCE controls as outlined under "PERIODIC ADJUSTMENTS".
10. Set the CH A AC-GND-DC switch to the AC position. Place the VOLTS/DIV switch to the .1V position and the VARIABLE control to the CAL position (fully clockwise). Check channel A and channel B independently. Apply the 1 kHz, 0.5 V p-p CAL signal from the front panel to the vertical input terminal. Vertical deflection should cover five divisions, or five divisions of horizontal deflection in the X-Y mode of operation.
11. Set the SWEEP TIME/DIV switch to the .1 ms position, and the VARIABLE control to the CAL position. One cycle of waveform should cover 10 divisions.
12. Apply a 30 MHz (20 MHz for 1525) signal from a signal generator to CH A input terminal. Set the SOURCE switch to the CH A position. Set the SWEEP TIME/DIV switch to the fastest sweep speed (0.2 μ s/division). Adjust the triggering LEVEL control for a synchronized display without jitter. Repeat this procedure for channel B.
13. Connect a synchronized waveform to the vertical input terminal as in Step 12. Depress the INTEN push-button. The first portion of the trace is of normal intensity. The delayed portion of the sweep will be brighter. The beginning of the brighter portion identifies the starting point of the delayed sweep. The delay time period is variable with the DELAY TIME controls.
14. Depress the CH A DLY'D pushbutton. The beginning of the channel A trace is delayed by the period selected by the DELAY TIME controls. When the CH B DLY'D pushbutton is pressed, the channel B trace is similarly delayed.
15. For the 1530 only, apply a very slow rate pulse (changes state each 5 seconds) to the vertical input terminals of channel A and channel B independently. Momentarily set the NORM-SINGLE-RESET switch to the RESET position. When released it will return to the center position. The READY indicator will light and the first trigger pulse initiates a single sweep. At

the end of the sweep, the READY light will go off. Another single sweep will not be generated until the NORM-SINGLE-RESET switch is placed in the RESET position.

BANDWIDTH

1. Use a signal generator with an amplitude flatness within 3% from 100 kHz to 30 MHz. Check channel A and channel B independently.
2. Apply a 100 kHz sine wave and adjust for an amplitude of six divisions on the screen. Keeping the signal level constant, gradually increase the frequency to 30 MHz (20 MHz for 1525). The amplitude should roll off gradually with no dips or peaks. At 30 MHz (20 MHz for 1525), the amplitude should be at least 4.2 divisions.

RISE TIME

Rise time is the period of time required for a pulse to rise from the 10% level to the 90% level of transition. See Fig. 22. The Model 1530 should have a rise time of 11.7 ns or less or 17.5 ns for Model 1525. Use a signal source with a rise time of 4 ns or less. Terminate the signal source with 50 ohms to prevent ringing. Measure channel A and channel B independently.

1. Apply a square wave or pulse with a rise time of 4 ns or less.
2. Set the SWEEP TIME/DIV switch to its fastest setting of 0.2 μ s/div., and the sweep VARIABLE control to the CAL position. Pull out the 5X MAG knob on the horizontal POSITION control. This produces a sweep time of 40 ns/division.
3. Adjust for six divisions amplitude as shown in Fig. 22.
4. Locate the 10% and 90% amplitude points and measure the time between these two points. The time difference should be 11.7 ns or less (approximately 3 mm) for Model 1530 or 17.5 ns (approximately 4.5 mm) for Model 1525.

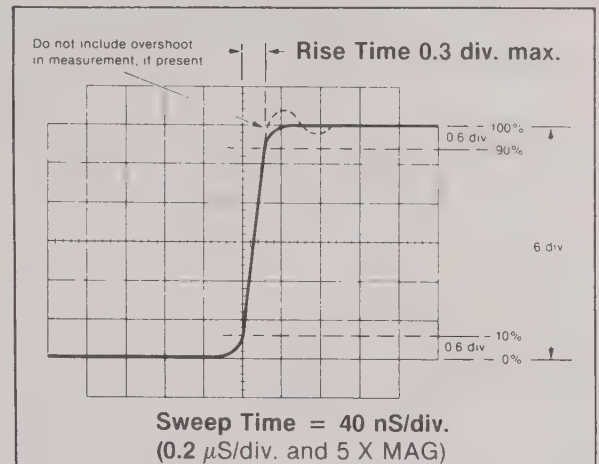


Fig. 22. Risetime Measurement.

For direct measurement of rise time, the rise time of the pulse should be at least three times as fast as the oscilloscope rise time. The "observed" rise time is actually the cascaded rise times of the pulse and the rise time of the oscilloscope, which are combined in square law addition as follows:

$$A = \sqrt{B^2 + C^2}$$

The effect of the pulse's rise time is almost negligible when its rise time is at least three times faster than that of the oscilloscope, but increases progressively as the rise time approaches that of the oscilloscope. If a signal source with a rise time of more than 4 ns must be used (the signal source rise time should never exceed 12 ns), the oscilloscope rise time may be calculated as follows:

$$C = \sqrt{A^2 - B^2}$$

Where:

- A is the Observed Rise Time.
- B is the Pulse Rise Time.
- C is the Scope's Rise Time.

CALIBRATION

GENERAL

This oscilloscope was calibrated at the factory before shipment. Readjustment is recommended only if repairs have been made in a circuit affecting calibration or if you have reason to believe the unit is out of calibration. Complete calibration procedures are given in this manual. However, calibration adjustments should be attempted only if the proper test equipment is available, and you are experienced and qualified in its use. If the test equipment used for calibration is less accurate than specified, the accuracy of the oscilloscope will be proportionately degraded. Perform related adjustments only in the specified sequence to prevent undesirable interaction of adjustments.

CALIBRATION CHECK

A general check of calibration accuracy may be made by displaying the output of the CAL 1kHz $\square$ 0.5V p-p terminal on the screen of the oscilloscope. This test signal provides a square wave of 0.5 volt peak-to-peak $\pm 3\%$, and period of 1 millisecond $\pm 3\%$. This signal may be used for probe compensation adjustment and for an approximate check of amplitude and time accuracy. However, the CAL signal should never be used for performing recalibration adjustments; a signal source with amplitude and time accuracy of 0.5% or better should be used for performing calibration adjustments.

TEST EQUIPMENT REQUIRED

The following items of test equipment are recommended for calibration of the Model 1525 or 1530 Oscilloscopes.

DC Voltmeter. 1% or better accuracy in the 100 mV to 200 V range (**B & K-Precision** Model 2815 or 2831 or equivalent).

High Voltage Multiplier Probe. 3% or better accuracy at 1.5 kV. Input impedance 100 megohms or greater (**B & K-Precision** Model PR-28 or equivalent).

Sine and Square Wave Generator. 100 Hz to 100 kHz range. Amplitude variable from 10 mV to 10 V peak-to-peak. Sine wave distortion 1% or less (**B & K-Precision** Model 3010, 3020, 3025, or 3030).

Fabricated RF Oscillator (Fig. 23).

Frequency Counter. 0.5% or better accuracy. 10 Hz to 10 MHz range (Any **B & K-Precision** frequency counter).

Oscilloscope Calibrator. Amplitude accuracy of 0.5% or better at 1 kHz at peak-to-peak amplitude of 50 mV, 0.5 V, 5 V and 10 V. Time marker accuracy of 0.5% or better at periods of 1 ms, 20 μ s, 0.5 μ s, and 0.2 μ s. Pulse rise time 4 ns or less (Zi-Tech 303, Ballantine Model 6125, or Tektronix Model PG-506 Calibration generator, PG-501 Time Mark Generator and TM-500 Series Mainframe, or equivalent).

Sweep Generator. At least 1 kHz to 30 MHz sweep. Amplitude flatness to 30 MHz within $\pm 3\%$. Frequency markers every 5 MHz.

PRELIMINARY PROCEDURE

Make sure that the line voltage is within 105-130 VAC for 120 volt operation or within 210-260 VAC for 240 volt operation. Warm up the oscilloscope and the calibrating instruments thoroughly (30 minutes) before starting.

Before starting adjustments, set operating controls as specified in Table 1. Each procedure assumes the operating controls to be in this initial condition and instructs any changes required.

NAME OF KNOB	POSITION
INTENSITY	3 o'clock
FOCUS	optimum position
MODE	CH A
Vert POSITION (CH A and B)	mechanical center
PULL 5 ► 2 mV (CH A and B)	Pushed in
VOLTS/DIV (CH A and B)	5 mV/div
VARIABLE (CH A and B)	CAL
AC-GND-DC (CH A and B)	DC (GND for no input signal)
CH B POLARITY	NORM
SOURCE	ALT
COUPLING	AC
SLOPE	"+"
TRIG LEVEL	mechanical center
PULL AUTO	pulled out
SWEEP TIME/DIV	1 ms/div
SWEEP VARIABLE	CAL
NORM-SINGLE (1530 only)	NORM
Hor POSITION	mechanical center
PULL X5 MAG	pushed in
HOLDOFF	NORM
PULL CHOP	Pushed in
FIX-NORM (1530 Only)	NORM
FRAME-LINE	LINE
INTEN'D	NORM
CH A DLY'D	NORM
CH B DLY'D	NORM
DELAY TIME	Any

Table 1. Initial Control Settings
for Calibration Adjustments.

POWER SUPPLY ADJUSTMENTS

Low Voltage Adjustment and Power Supply Voltage Checks

1. Connect a dc voltmeter to measure the voltage at P306, pin 8 with respect to chassis ground.
2. Adjust VR304 for +108.5 V on voltmeter.
3. Connect a dc voltmeter to measure the voltage at each of the points listed in Table 2 with respect to chassis ground. Voltage readings should also be approximately as listed in Table 2.

MEASURE	VOLTAGE
P306, pin 2	-8 V
P306, pin 3	+5 V
P306, pin 4	+15 V
P306, pin 5	+10 V
P307, pin 8	+124 V

Table 2. Power Supply Checks.

High Voltage Adjustment

1. Connect a dc voltmeter with high voltage, high impedance probe (at least 100 Megohms impedance) to P301 pin 9.
2. Adjust VR303 to obtain -1.5 kV on voltmeter.

INTENSITY AND DISPLAY ADJUSTMENTS

FOCUS and ASTIGmatism Adjustment

Adjust the focus and astigmatism as outlined in the OPERATOR MAINTENANCE section.

Intensity Theshold Adjustment

1. Set the LEVEL control to the AUTO position (out) to obtain a sweep.

CALIBRATION

2. Adjust VR302 so the trace just disappears as the INTENSITY control is reduced to the 10 o'clock position.

Blanking Adjustment

1. Set SWEEP TIME/DIV control to 0.2 μ s (fastest speed). The LEVEL switch must be pulled (AUTO position) to obtain trace.
2. Use the minimum INTENSITY setting that will produce a visible trace. With the correct setting, some of the trace will be visible, but the beginning of the trace will not appear.
3. Adjust TC301 to unblank the trace at the earliest possible point; i.e., so the trace becomes visible as far to the left as possible.

VERTICAL AXIS ADJUSTMENTS

Vertical Centering

The first vertical axis adjustment is to establish dc balance in the vertical output amplifier. This is accomplished by shorting the input of the output amplifier to eliminate any residual unbalance from the preamplifier section, and adjusting for a vertically centered trace.

1. Short P401 to P402 on vertical amplifier board.
2. Adjust VR402 to center trace vertically.
3. Remove short from step 1.

DC Balance

Adjust the DC balance as specified in the OPERATOR MAINTENANCE section.

Channel B Polarity and Position Adjustments

1. Set Channel A and Channel B AC-GND-DC switches to GND position.
2. Set MODE switch to CH B. Select AUTO triggering to obtain trace.

3. Alternately select normal and inverted polarity with CH B POLARITY pushbutton switch. Adjust VR112 so CH B trace does not shift when CH B POLARITY switch is operated.

4. Select DUAL Mode.

5. Verify channel A and B POSITION controls are mechanically centered. Be sure to use center of mechanical rotation. If necessary, loosen knob set screw and reposition knob pointer to top (12 o'clock).
6. Adjust VR105 and VR402 to superimpose both traces in the center of screen.

2 mV Center Adjustment

1. Set the CH A AC-GND-DC switch to the GND position and the SWEEP TIME/DIV control to the 1 ms position.
2. Alternately push and pull PULL 5 $\blacktriangleright$ 2 mV knob. Adjust VR117 (VR114 on earlier Model 1530) so trace does not shift when knob is pulled.
3. Repeat the entire procedure for CH B, adjusting VR118 (VR115 on earlier Model 1530).

Vertical Gain Adjustments

1. Set MODE switch to CH A.
2. Apply calibrated 20 mV p-p 1 kHz square wave to CH A input.
3. Set CH A VARIABLE control to CAL and VOLTS/DIV to 5 mV.
4. Adjust VR401 for exactly 4 divisions vertical amplitude.
5. Repeat the procedure for CH B, adjusting VR110.

Input Capacitance

The object of this procedure is to equalize the input capacitance for all sections of the vertical attenuator. This is accomplished by

first using the non-adjustable capacitance of the input FETs on the non-attenuated range (5 mV/div) as reference, then trimming the input capacitor of each attenuator section to match. A measurement corresponding to the reference capacitance is established by connecting it as the tuning capacitor of a test oscillator (Fig. 23). This causes the test oscillator to operate at a reference frequency. The reference frequency is measured on a frequency counter. The specific frequency at which the test oscillator operates is not critical, but the frequency should be stable at approximately 5 MHz. The attenuator is then switched to other ranges. For each attenuator section, the associated trimmer capacitor is adjusted so the test oscillator again operates at the reference frequency. A non-metallic tool should be used for adjusting trimmers.

1. Build the test oscillator shown in Fig. 23 and connect it to the frequency counter and the CH A input of the oscilloscope as shown. No input signal is applied during this procedure

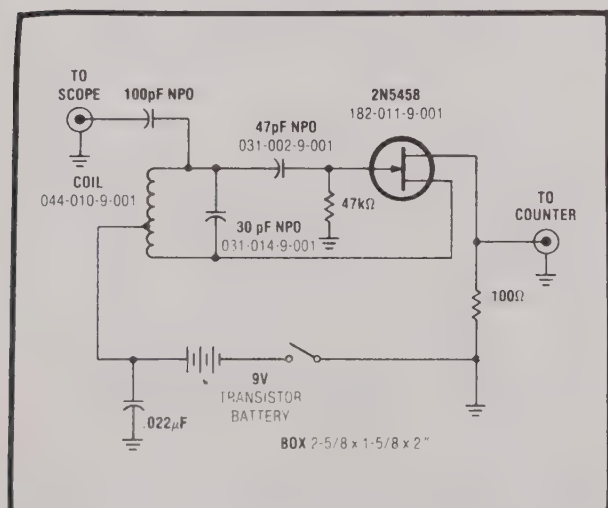


Fig. 23. Schematic of Test Oscillator for Input Capacitance Adjustment.

2. Turn on the oscilloscope to stabilize the input capacitance of the input FET amplifier.

3. Set CH A VOLTS/DIV control to 5 mV.
4. Measure and record reference frequency of test oscillator on frequency counter.
5. Set CH A VOLTS/DIV control to other ranges and adjust corresponding trimmer to match reference frequency recorded in step 4, as listed in Table 3.
6. Connect test oscillator to CH B INPUT and repeat adjustments for CH B as listed in Table 4.

CH A VOLTS/DIV	ADJUST
5 mV	reference
50 mV	TC102
0.5 V	TC104
5 V	TC111

Table 3. CH A Input Capacitance Adjustments

CH B VOLTS/DIV	ADJUST
5 mV	reference
50 mV	TC107
0.5 V	TC109
5 V	TC112

Table 4. CH B Input Capacitance Adjustments.

Input Capacitance, Alternate Method

An alternate method of adjusting input capacitance, although not as accurate as the previous method, may be used if the test oscillator of Fig. 23 is not available. This method requires the simpler network shown in Fig. 24. This network is essentially a 2:1 probe, since the 1 MΩ resistance of the network and the 1 MΩ input resistance of the vertical attenuator form a voltage divider. A 10:1 probe could also be used, except that a square wave of at least 100 volts p-p (not commonly available) would be required for adjustment of the 5 V/div attenuator setting.

1. Connect the network of Fig. 24 between a square wave generator and the CH A INPUT of the oscilloscope.
2. Set the CH A VOLTS/DIV control to 5 mV and apply sufficient 1 kHz square wave for 5 divisions amplitude. Set sweep time for one or two cycles of displayed square wave.
3. Adjust the external trimmer for the ideal square wave characteristic per Fig. 25. This is the reference square wave. The external trimmer should not be readjusted after this step.
4. In turn, set the CH A VOLTS/DIV control to 50 mV, 0.5 V, and 5 V ranges. At each setting, increase the square wave generator output to display a square wave of 2 to 5 divisions amplitude. Adjust the corresponding internal trimmer (see Table 3) to match reference square wave characteristic displayed in step 3.
5. Repeat adjustments for CH B, adjusting the trimmers listed in Table 4.

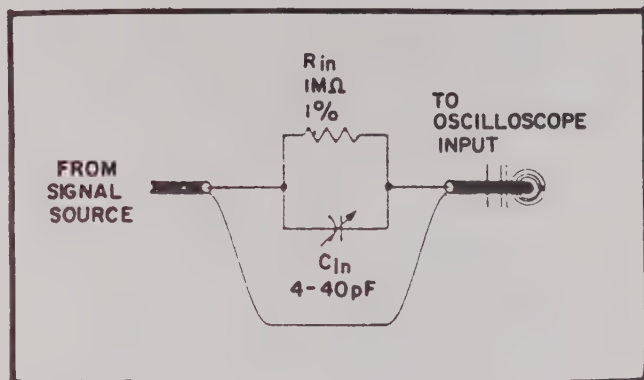


Fig. 24. Network for Alternate Input Capacitance Adjustment.

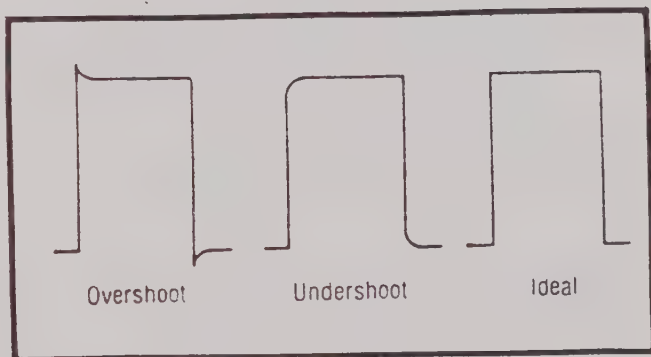


Fig. 25. Adjusting 1 kHz Square Wave Characteristic.

Vertical Attenuator Frequency Compensation

The purpose of this procedure is to equalize frequency compensation trimmers for all sections of the vertical attenuator. This is accomplished by first applying a 1 kHz square wave in an unattenuated range (5 mV/div) and using the displayed waveform for reference. The vertical attenuator is then switched to other ranges and the corresponding trimmer adjusted to obtain the same square wave characteristics as the reference waveform.

This procedure must be performed after the "Input Capacitance" adjustments.

1. Set CH A VOLT/DIV control to 5 mV and apply 1 kHz square wave signal. Adjust signal generator level to 20 mV p-p, which should give a square wave display of 4 divisions amplitude. Set sweep time to display one or two cycles of square wave signal.
2. Observe square wave characteristics for reference. See Fig. 25 for desired wave-shape.
3. In turn, set the CH A VOLTS/DIV control to 50 mV, 0.5 V, and 5 V ranges. At each setting, increase the square wave generator output as listed in Table 5. This will display a square wave of 2 to 4 divisions amplitude. Adjust the corresponding trimmer listed in Table 5 to match the reference square wave characteristic displayed in step 2.

- Repeat adjustments for CH B, adjusting the trimmers listed in Table 6.

CH A VOLTS/DIV	INPUT	ADJUST
5 mV	20 mV p-p	Reference
50 mV	200 mV p-p	TC101
0.5 V	2 V p-p	TC103
5 V	10 V p-p	TC105

Table 5. CH A Vertical Attenuator Frequency Compensation Adjustments.

CH B VOLTS/DIV	INPUT	ADJUST
5 mV	20 mV p-p	Reference
50 mV	200 mV p-p	TC106
0.5 V	2 V p-p	TC108
5 V	10 V p-p	TC110

Table 6. CH B Vertical Attenuator Frequency Compensation Adjustments.

Vertical Amplifier Frequency Compensation

These adjustments of the vertical output amplifier extend the -3 dB bandwidth to at least 30 MHz for Model 1530, to at least 20 MHz for Model 1525. Proper adjustment is critical to accuracy and non-distorted display at high frequencies. The best results can be obtained by alternately using a combination of two methods. The first is by observing the leading edge of a 100 kHz square wave and adjusting for best waveshape. The second is by observing the frequency response display using a sweep generator with a flat response from 1 kHz to at least 30 MHz (20 MHz for Model 1525). Since all adjustments interact to some degree, it is advisable to repeat the procedure until no improvement can be obtained, typically three times.

- Set MODE and SOURCE switches to CH B and CH B VOLTS/DIV to 5 mV.

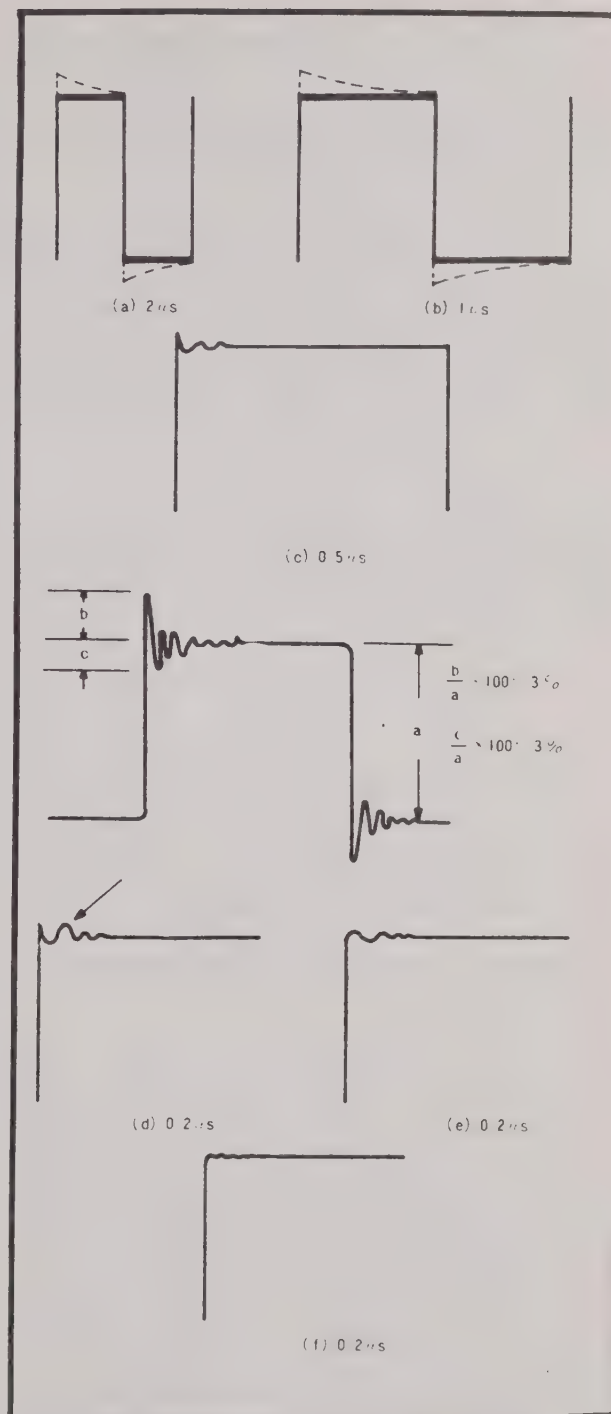


Fig. 26. Vertical Amplifier Frequency Compensation Adjustment.

2. Apply 100 kHz square wave with fast rise time to CH B input. The square wave must be terminated into 50 ohms.
3. Adjust square wave amplitude for 6 divisions of amplitude.
4. Rotate SWEEP TIME/DIV control from 2 μ s to 0.2 μ s, observing the leading edge of the square wave as in Fig. 26. Make adjustments in the sequence listed in Table 7 for best overall square wave characteristic. Overshoot must be less than 3% (0.2 division). However, do not eliminate all overshoot as high frequency response will be degraded.

SWEEP TIME	ADJUST	FUNCTION
2 μ s/div	TC403	Mid-Freq
2 μ s/div	VR404	Mid-Freq
1 μ s/div	TC401*	Hi-Freq
1 μ s/div	VR403	Hi-Freq
0.5 μ s/div	TC402	Hi-Freq
0.2 μ s/div	TC404*	Hi-Freq
0.2 μ s/div	VR405*	Hi-Freq
* Omitted in Model 1525.		

Table 7. Vertical Amplifier Frequency Compensation Adjustment Sequence.

5. Disconnect 100 kHz square wave generator and connect rf output of sweep generator to CH B input. Set generator to sweep from 1 kHz to at least 30 MHz (20 MHz for Model 1525) with frequency markers each 5 MHz. A display similar to Fig. 27 should be displayed for Model 1530. For Model 1525, there should be at least 4.2 divisions at 20 MHz. Set sweep generator level for 6 divisions amplitude at lower frequencies. Repeat adjustments of step 4 for smooth roll off at higher frequencies and amplitude of at least 4.2 divisions (-3 dB) at 30 MHz for Model 1530, 20 MHz for Model 1525.

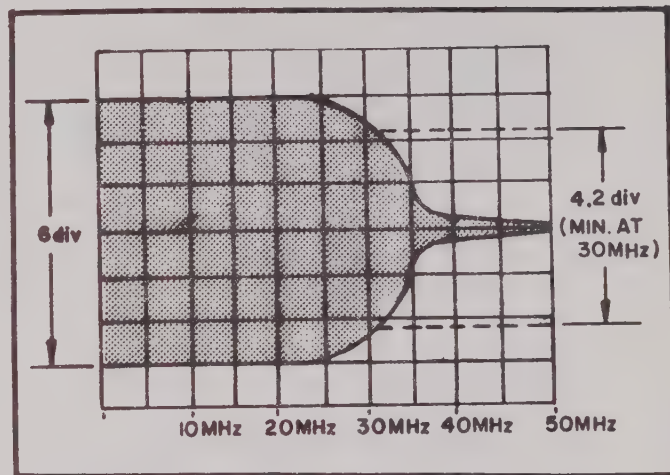


Fig. 27. Frequency Response Display.

6. Repeat procedure if needed for optimum waveform and frequency response curve.
7. Switch to dual-trace mode and simultaneously apply sweep generator signal to both CH A and CH B. Use CH A and CH B POSITION controls to superimpose frequency response curves. Adjust TC113 so channel A response curve most closely matches channel B.

Final Vertical Adjustment

Repeat "DC Balance" adjustments for channel A and B. This is a very important step that must be performed before "Triggering Adjustments".

HORIZONTAL AXIS ADJUSTMENTS

Sweep Time and Sweep Length

1. Set SWEEP TIME/DIV control to 1 ms and apply 1 ms marker signal to CH A.
2. Apply 1 ms time mark ($\pm 0.5\%$) or 1 kHz square wave ($\pm 0.5\%$).

3. Adjust VR15 so 10 marks exactly occupy 9 divisions as shown in Fig. 28 (first mark may not be visible).
4. Adjust VR6 for total sweep length to approximately 10.5 divisions (Fig. 28).

1 μ s, 0.5 μ s and 0.2 μ s Sweep Time Adjustments

1. Set SWEEP TIME/DIV control to 1 μ s, 0.5 μ s, and 0.2 μ s while applying the corresponding marker signal (see Table 8) to display 11 waves on the CRT screen.
2. Adjust TC1, TC2, and VR5 so that the 11 markers occupy exactly 10 divisions (Fig. 28). The first marker may not be visible.

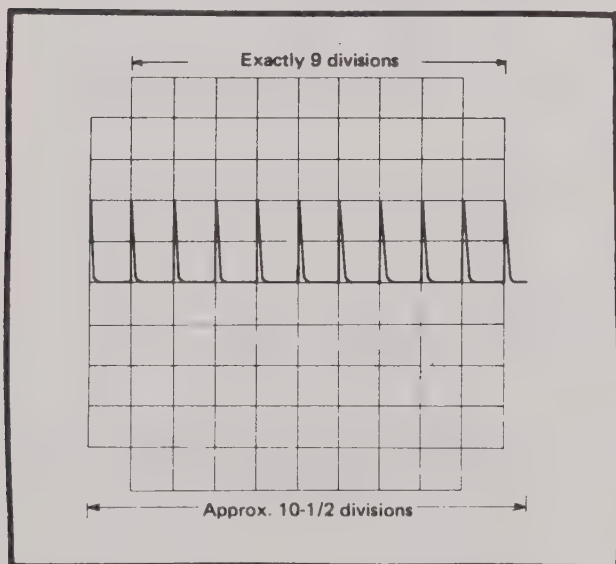


Fig. 28. Sweep Time and Sweep Length Adjustment.

SWEEP TIME	MARKER SIGNAL	ADJUST
1 ms/div	1 ms	VR15
1 μ s/div	1 μ s	TC1
0.5 μ s/div	0.5 μ s	TC2
0.2 μ s/div	0.2 μ s	VR5

Table 8. Sweep Time Adjustments.

Linearity Adjustment

1. Select 20 μ s/div sweep time and 5X MAG. Apply 250 kHz sine wave at 6 divisions amplitude. Adjust TC3 for best linearity i.e., so each cycle has equal spacing (Fig. 29).
2. Set sweep time to 0.2 μ s and apply 25 MHz sine wave (20 MHz for Model 1525) at 2 divisions amplitude. Pull 5X MAG switch out and use horizontal POSITION control to start wave at left edge of scale. Adjust TC4 for best linearity (Fig. 29).
3. Linearity adjustments interact with sweep time calibration adjustments. Recheck sweep time calibration. If necessary, repeat sweep time and linearity adjustments to eliminate interaction.

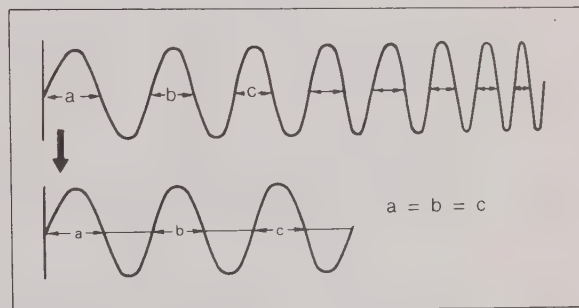


Fig. 29. Linearity Adjustment.

Horizontal POSITION Adjustment

1. Set SWEEP TIME/DIV control to 0.2 ms and apply 1 ms marker signal to CH A to display three pulses on screen (Fig. 25).
2. Set horizontal POSITION control at mechanical center. Be sure to use the mechanical center of rotation. If necessary, loosen knob set screw and reposition knob pointer to top (12 o'clock) before adjustment. Adjust VR10 to center pulses on screen (Fig. 30).

X5 MAG Centering and Gain Adjustments

1. Set SWEEP TIME/DIV control to 1 ms and apply 1 ms marker signal to CH A input. Markers will be 1 division apart (Fig. 30).
2. Pull out the PULL 5X MAG knob and adjust VR14 so there are 5 divisions between marks (Fig. 30).
3. With 1 ms markers still applied, set sweep time to 0.2 ms/div. Without 5X MAG there should be three markers displayed (Fig. 30). Set horizontal POSITION control so center marker is in center of screen.
4. Alternately push and pull PULL 5X MAG knob, being careful not to rotate the POSITION control. Adjust VR13 so center marker is at same point with X5 MAG on and off.

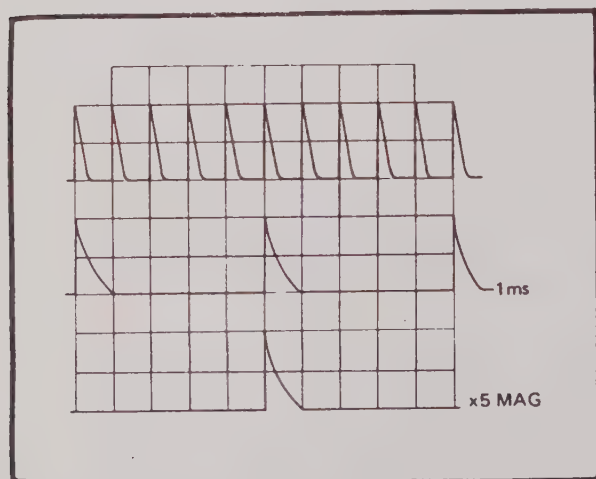


Fig. 30. X5 MAG Centering and Gain Adjustment.

X Position Adjustment

1. Set CH B position control to mechanical center (pointer to 12 o'clock).
2. Set channel AC-GND-DC switch to GND.

3. Select X-Y operation (SWEEP TIME/DIV to CH B). Turn down INTENSITY to prevent spot from burning tube.
4. Adjust VR12 to center spot on screen.

X Gain Adjustment

1. Set Channel B AC-GND-DC to AC, VOLTS/DIV to 5 mV, and VARIABLE to CAL.
2. Apply calibrated 20 mV p-p, 1 kHz square wave to channel B input.
3. Adjust VR11 to obtain 4 divisions of horizontal deflection (Fig. 31).

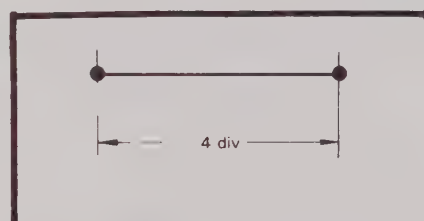


Fig. 31. Horizontal Gain Adjustment.

TRIGGERING ADJUSTMENTS

Off-Set Adjustment

1. Set LEVEL control to mechanical center. Be sure to use center of mechanical rotation. If necessary, loosen knob set screw and reposition knob pointer to top (12 o'clock).
2. Set FRAME-LINE switch to LINE, FIX-NORM switch to NORM, and COUPLING switch to AC.
3. Short IC5, pins 1 and 2 (P14 and P15).
4. Connect a calibrated oscilloscope to the wiper of SLOPE switch S5a (P13).
5. Alternately change SLOPE switch setting between (+) to (-) and adjust VR7 for minimum voltage change when switch is operated. This compensates for any dc offset in Schmitt trigger IC5.

TRIG LEVEL Center Adjustment

1. Continue to monitor the voltage from SLOPE switch S5a (as in previous "Off-Set Adjustment" procedure).
2. TRIG LEVEL control must remain at its mechanical center (12 o'clock).
3. With no input signal applied (both AC-GND-DC switches set to GND), alternately connect and remove the short across IC5 input, pins 1 and 2. Adjust VR19 so voltage does not change when short across IC5 input is removed.

(+) and (-) Trigger Adjustment

1. Set TRIG LEVEL control to its mechanical center (12 o'clock).
2. Apply 1 kHz sine wave to CH B to display 6 divisions of amplitude.
3. Set SLOPE to positive (+). Decrease waveform amplitude and adjust VR18 to trigger at less than 0.5 div amplitude as displayed on CRT.
4. Set SLOPE to negative (-) and adjust VR17 to trigger at less than 0.5 div amplitude as displayed on CRT.
5. Check that the starting point of the waveform does not shift when the SLOPE switch is changed between (+) to (-).

FIX Adjustment

This adjustment applies only to earlier Model 1530 (Serial No. 07-05000 and lower).

1. Set FIX/NORM switch to FIX position.
2. Apply 1 kHz sine wave to CH A to display 6 divisions of amplitude.
3. Reduce signal level and adjust VR9 so signal will trigger below 0.5 div, and so starting point of waveform does not shift when SLOPE switch is changed from (+) to (-).

CH B DC Coupling Adjustment

1. Set MODE switch to CH B.
2. Apply 1 kHz sine wave at 6 div amplitude (input signal must not contain a dc component).
3. Using AC COUPLING, adjust TRIG LEVEL control so starting point of waveform does not change when SLOPE switch is changed between (+) and (-).
4. Set VR20 to mechanical center. Adjust VR11 so starting point of waveform does not shift when COUPLING switch is changed between AC and DC. If VR11 reaches adjustment limit, alternately adjust VR20 and VR11.

CH A DC Coupling Adjustment

1. Set MODE switch to DUAL and COUPLING switch to DC.
2. Connect same 1 kHz sine wave to CH A and CH B inputs. Adjust for 6 div amplitude.
3. Adjust VR113 so starting point of waveform does shift when SOURCE switch is changed between CH A and CH B.

CAL SQUARE WAVE ADJUSTMENTS

1. Perform vertical axis and horizontal axis calibration before adjusting CAL square wave.
2. Connect CAL 1 kHz  0.5 V P-P terminal on front panel to CH B. Set SWEEP TIME/DIV to 0.1 ms/div and VOLTS/DIV to 0.1 V/div.
3. Adjust VR1 to display 0.5 volts peak-to-peak (5 divisions amplitude at 0.1 V/div sensitivity).
4. Adjust VR2 for 0.5 ms time period for the positive half of the square wave (5 divisions at 0.1 ms/div sweep time). Adjust VR3 for 0.5 ms time period for

the negative half of the square wave.
See Fig. 32.

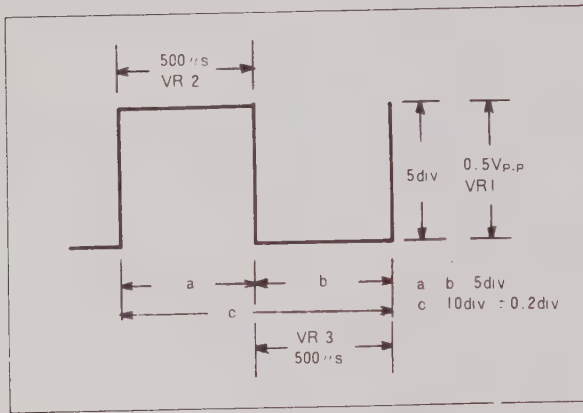


Fig. 32. CAL Square Wave Adjustment.

VERTICAL AMPLIFIER BOARD			
VR101	CH A Vari. Atten Bal	TC101	CH A 10:1 Sq Wave Comp
VR103	CH A Step Atten Bal	TC102	CH A 10:1 Input Capacitance
VR105	CH A Vertical Position	TC103	CH A 100:1 Sq Wave Comp
VR106	CH B Vari. Atten Bal	TC104	CH A 100:1 Input Capacitance
VR108	CH B Step Atten Bal	TC105	CH A 250:1 Sq Wave Comp
VR110	CH B Gain	TC106	CH B 10:1 Sq Wave Comp
VR111	X-Gain	TC107	CH B 10:1 Input Capacitance
VR112	CH B Polarity Invert	TC108	CH B 100:1 Sq Wave Comp
VR113	CH A DC Trig Level	TC109	CH B 100:1 Input Capacitance
VR117	CH A 2 mV centering (VR114 on early Model 1530)	TC110	CH B 250:1 Sq Wave Comp
VR118	CH B 2 mV centering (VR115 on early Model 1530)	TC111	CH A 250:1 Input Capacitance
		TC112	CH B 250:1 Input Capacitance
		TC113	CH A High Frequency
VERTICAL OUTPUT AMPLIFIER BOARD			
VR401	CH A Gain	TC401	High Freq Response
VR402	CRT Vertical Centering (CH B Position)		(1530 only)
VR403	High Freq Response	TC402	High Freq Response
VR404	Mid Freq Response	TC403	Mid Freq Response
VR405	High Freq Response (1530 only)	TC404	High Freq Response (1530 only)
HORIZONTAL SWEEP BOARD			
VR 1	CAL Amplitude	VR14	X5 MAG Gain
VR 2	CAL 0V Period	VR15	Sweep Time (1 ms)
VR 3	CAL 0.5V Period	VR17	- SLOPE adjust
VR 5	0.2 μ s Sweep Time	VR18	+ SLOPE adjust
VR 6	Sweep Length	VR19	TRIG LEVEL centering
VR 7	Trigger Offset	VR20	CH B DC Trigger Level (coarse)
VR 9	FIX Level (early 1530 only)	TC 1	1 μ s-50 μ s Sweep Time
VR10	Hor Position	TC 2	0.5 μ s Sweep Time
VR11	CH B DC Trigger Level (fine)	TC 3	1 μ s-50 μ s Sweep Linearity
VR12	X Position	TC 4	0.2 μ s Sweep Linearity
VR13	X5 MAG Centering		
POWER SUPPLY BOARD			
VR302	INTENSITY Threshold	VR304	+108.5 V Adj.
VR303	-1.5 kV Adj.	TC301	Blanking

Table 9. Functions of Adjustments.

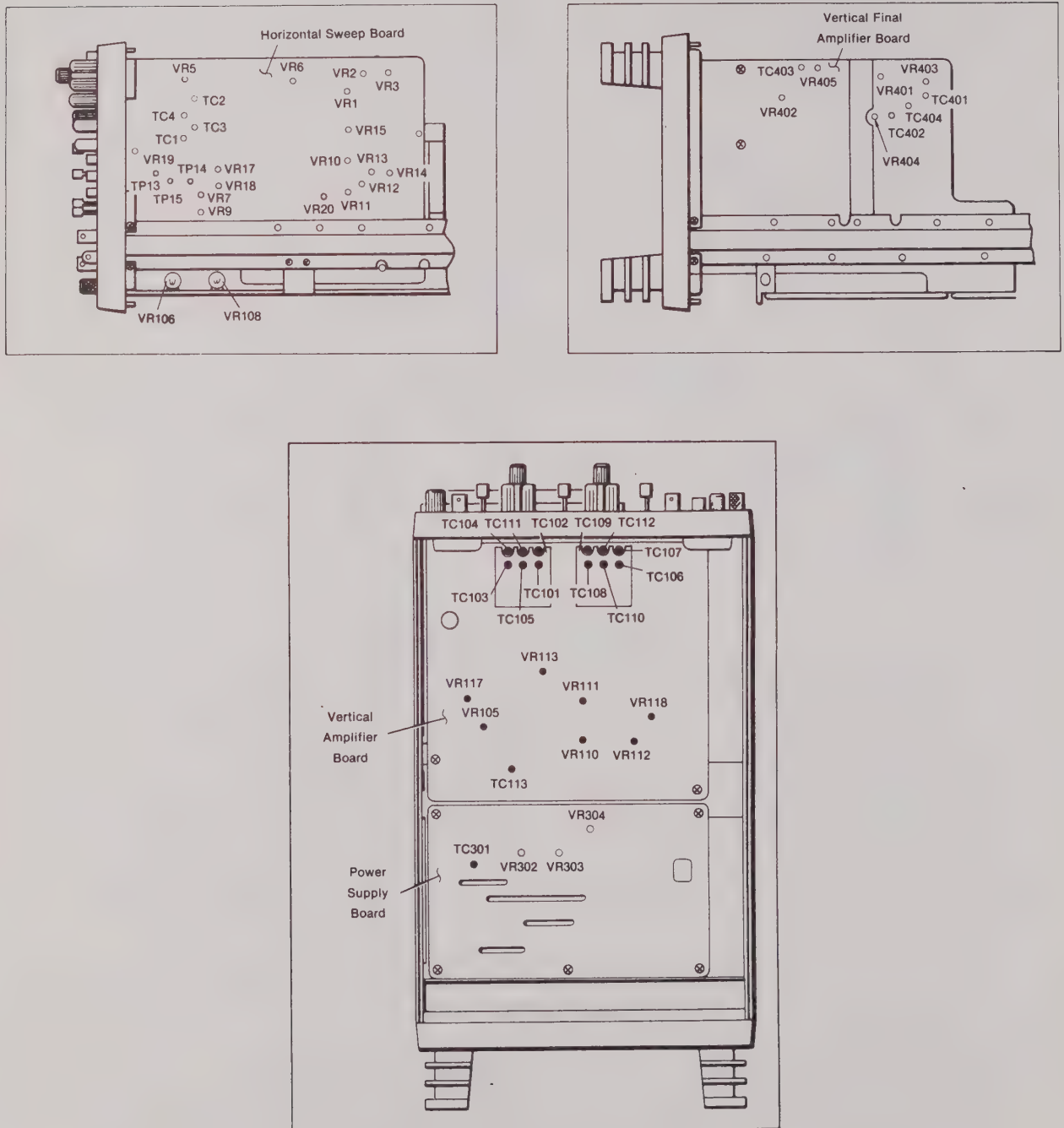
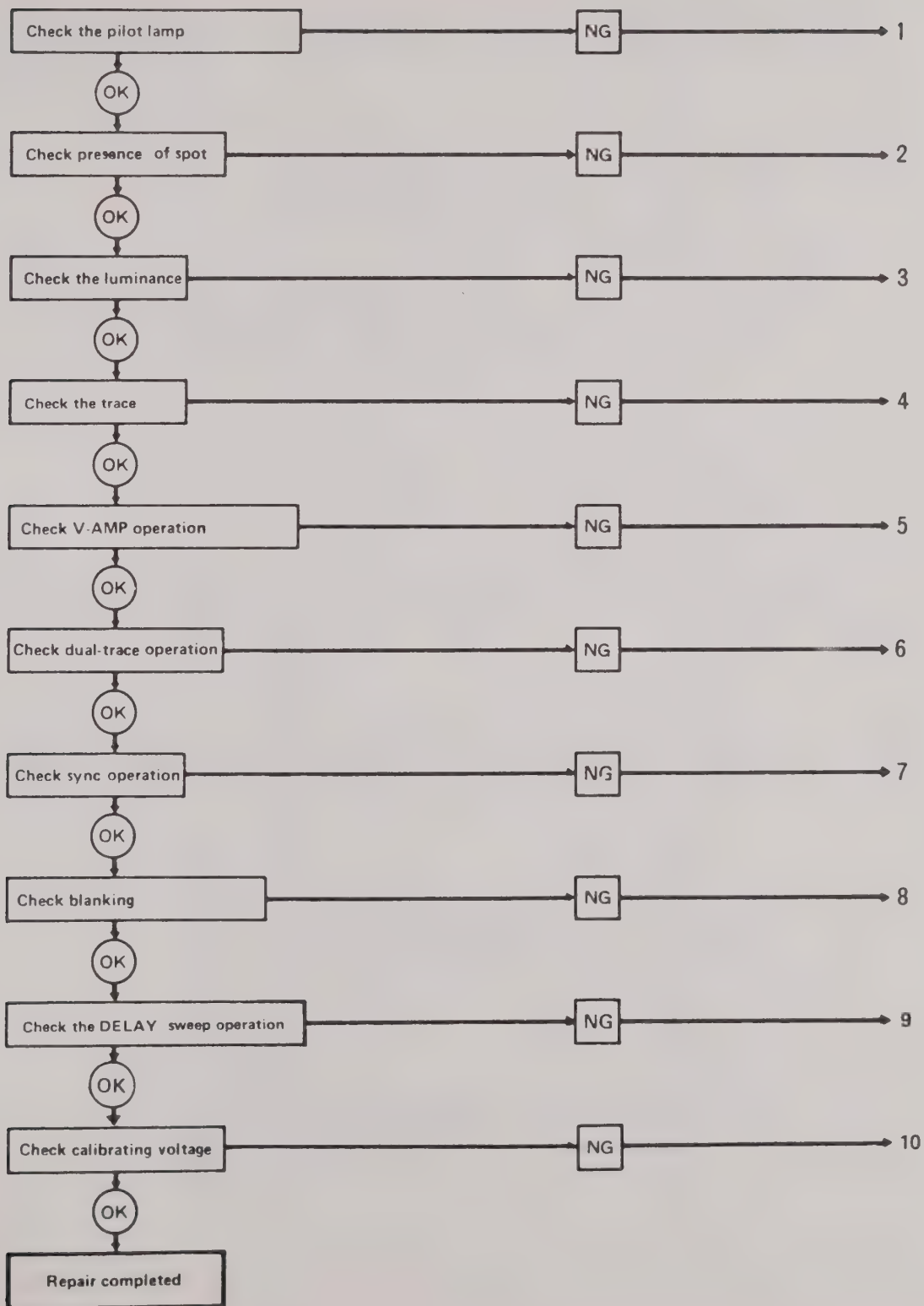


Fig. 33. Location of Calibration Adjustments.

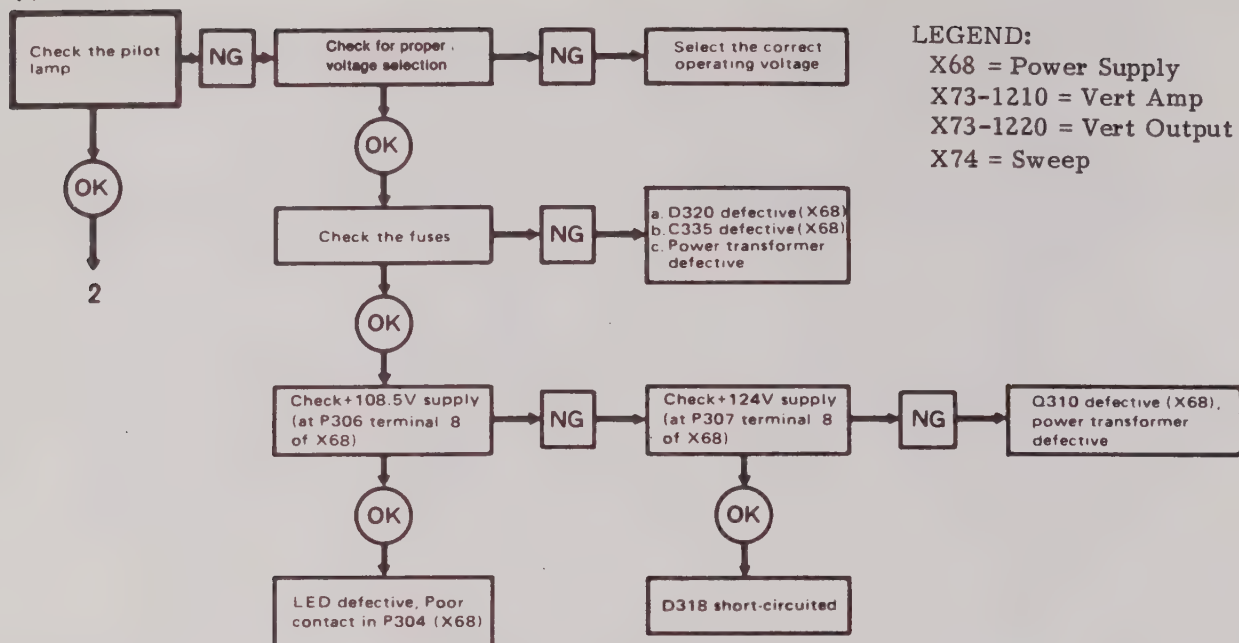
TROUBLESHOOTING

TROUBLESHOOTING



TROUBLESHOOTING

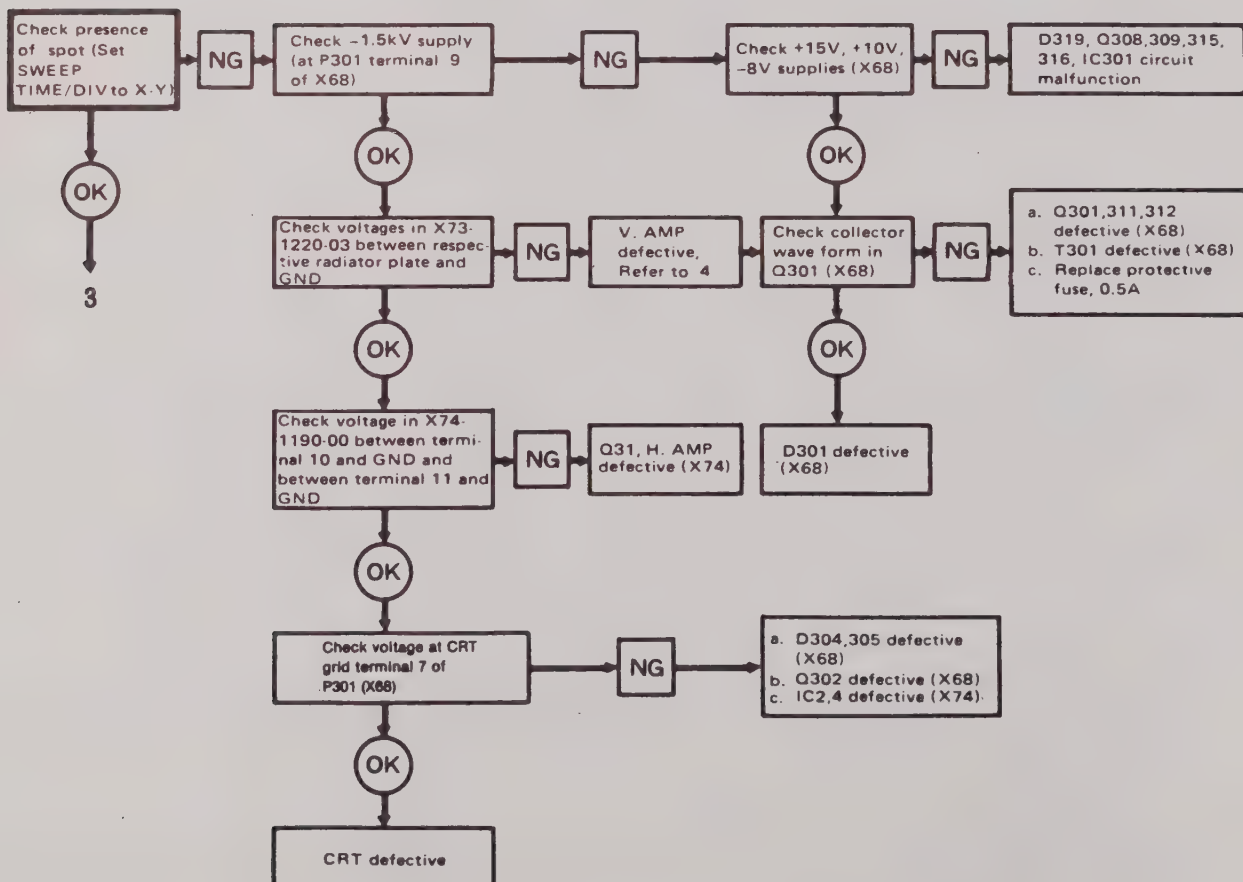
1.



LEGEND:

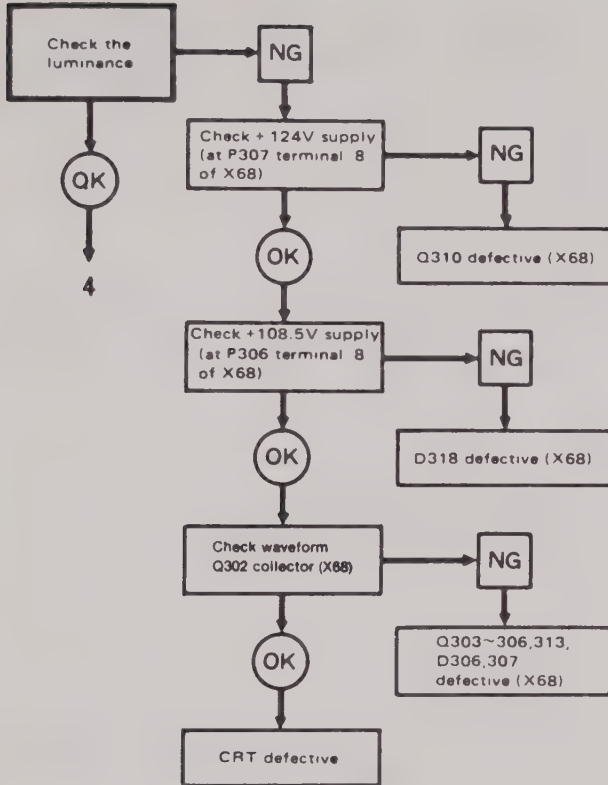
X68 = Power Supply
X73-1210 = Vert Amp
X73-1220 = Vert Output
X74 = Sweep

2.

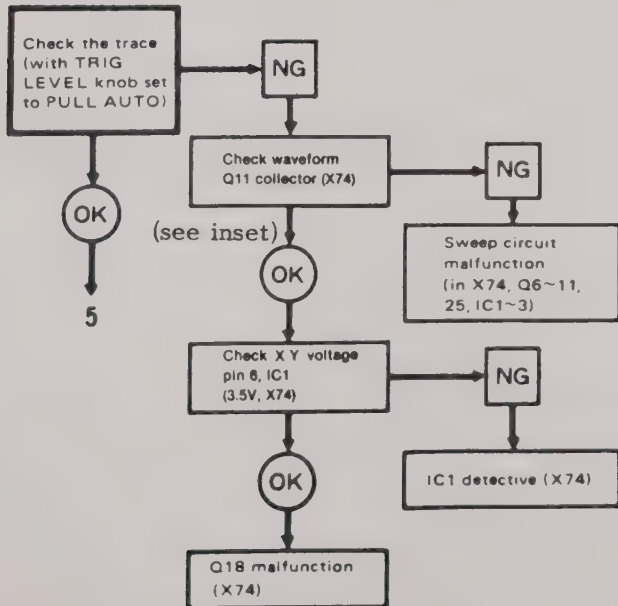


TROUBLESHOOTING

3.

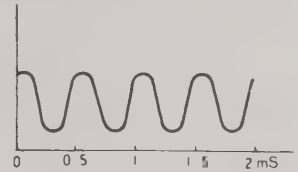


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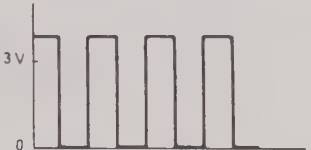


Waveform in Sweep Circuit
(Input signal 2 kHz sine wave,
SWEEP TIME 0.1 ms/div)

No. 6 pin of IC5
(trigger AMP output)



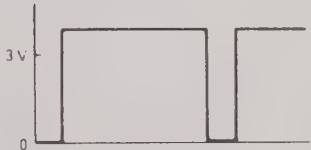
No. 8 pin of IC1
(Schmitt output)



No. 2 pin of IC2
(frep-flop gate "R")



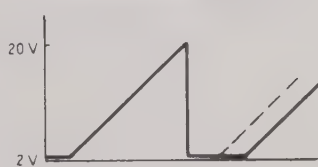
No. 13 pin of IC2
(frep-flop gate "S")



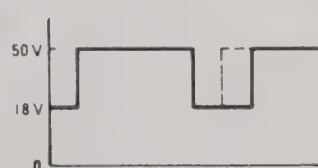
No. 8 pin of IC2
(frep-flop gate "Q")



Collector of Q11
(Miller integrator
output)



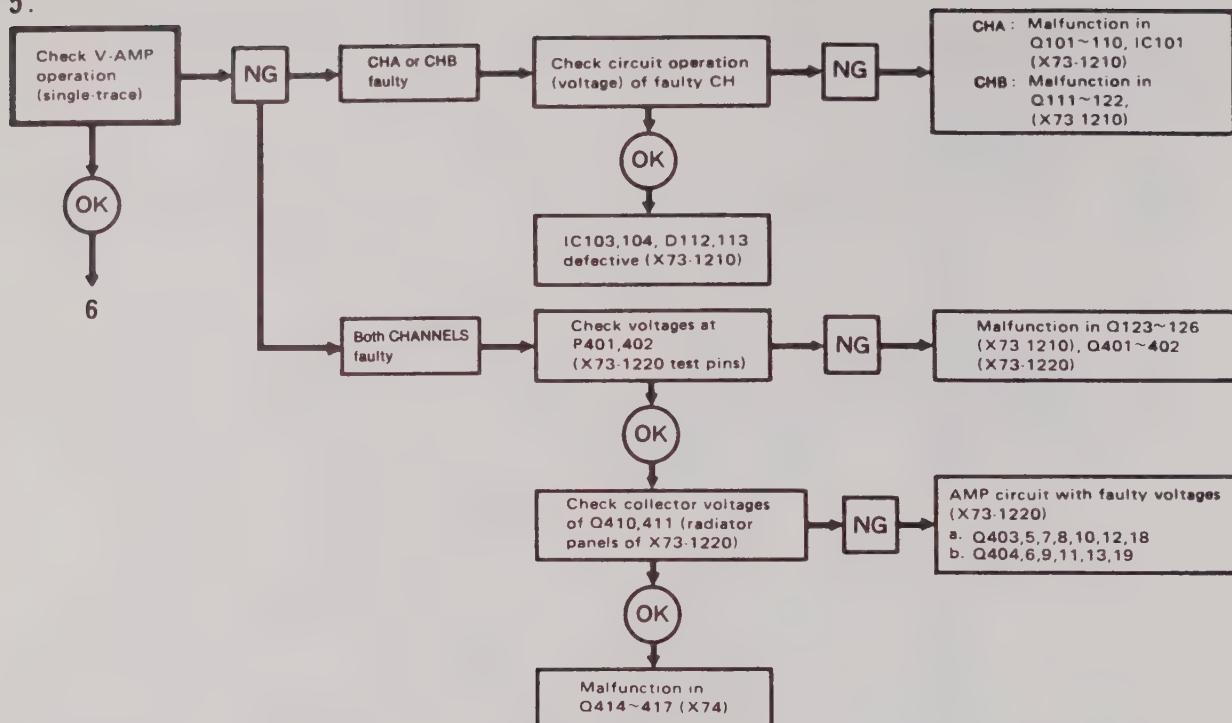
Collector of Q305
(X68) (unblanking
output)



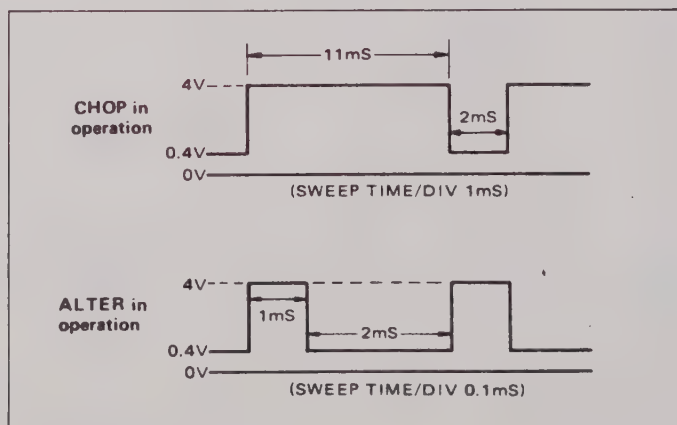
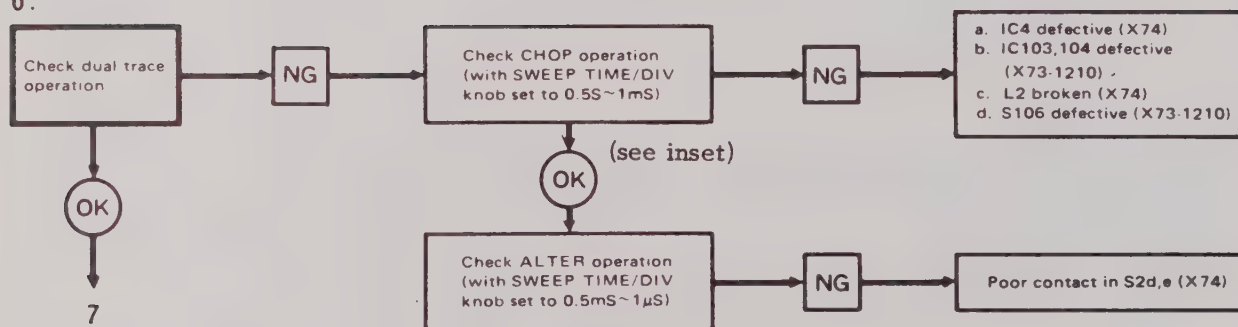
(Chain lines for free running)

TROUBLESHOOTING

5.



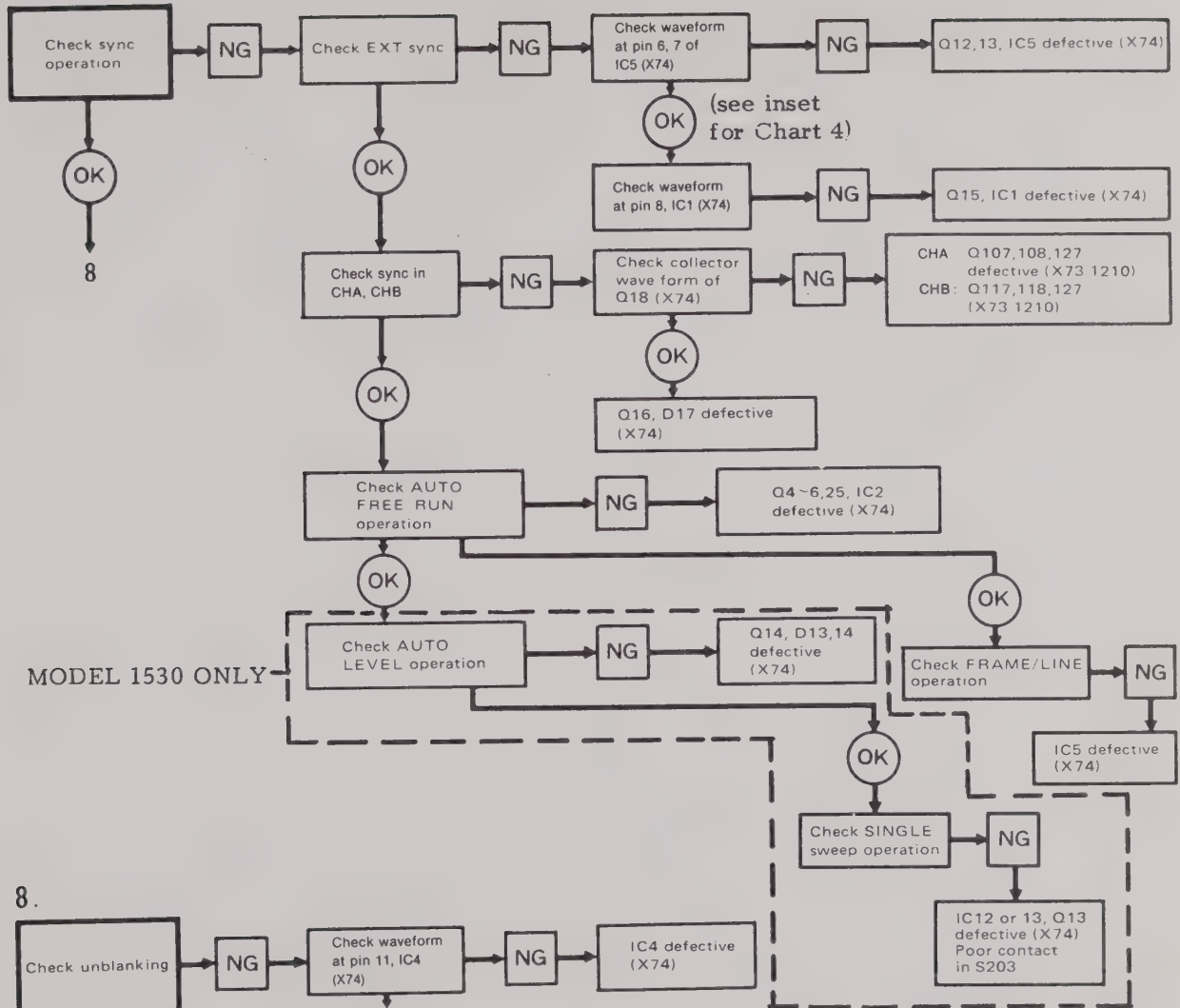
6.



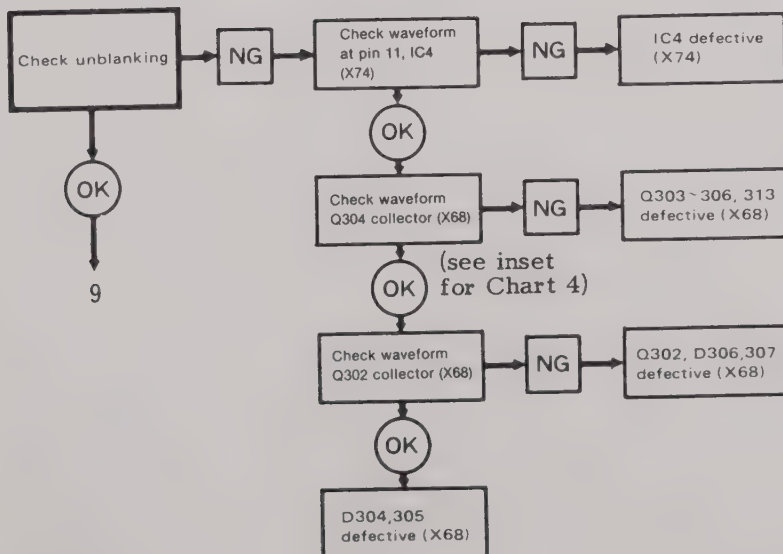
Clock Pulse Waveforms
at J1, Terminal 5

TROUBLESHOOTING

7.

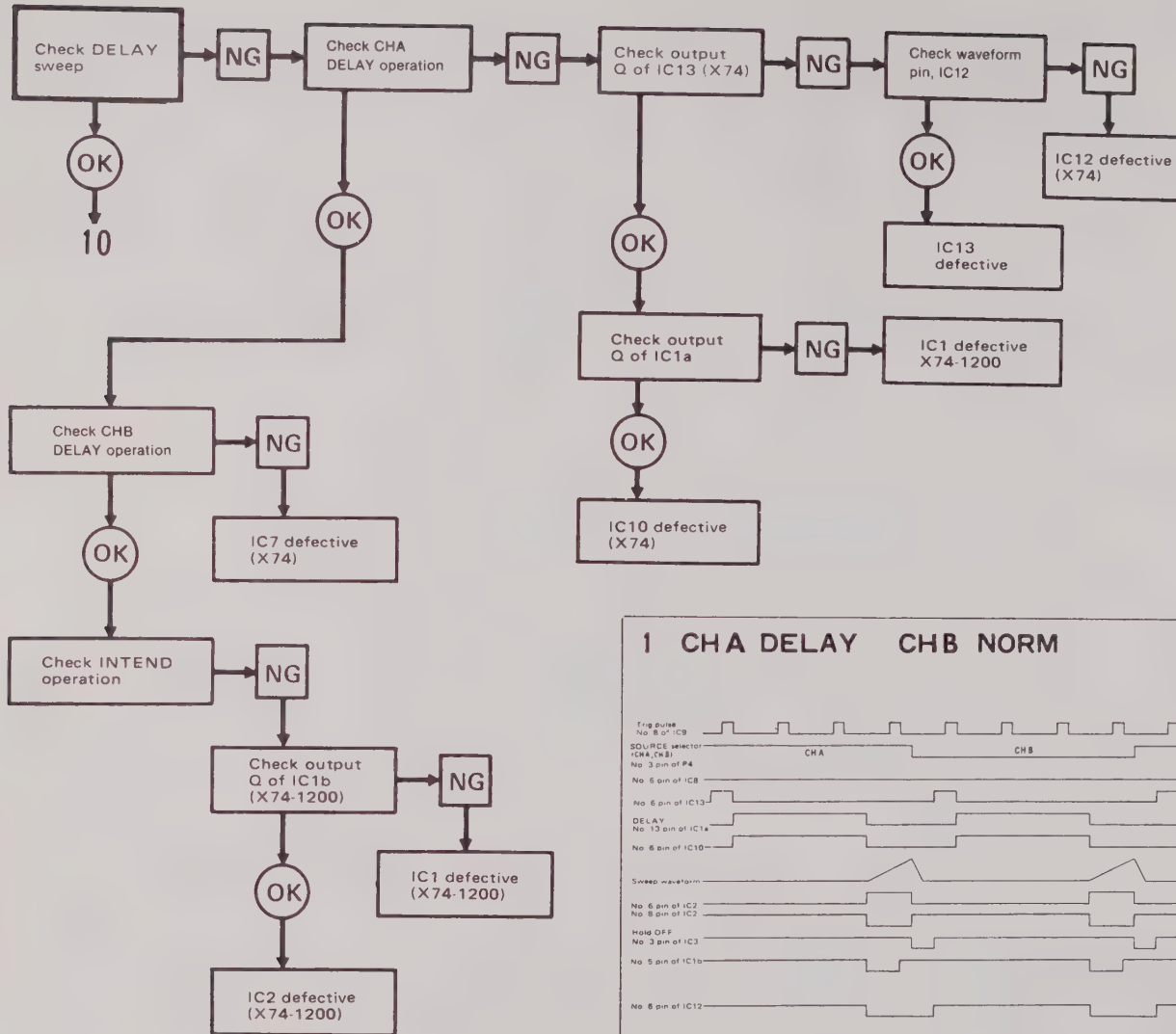


8.

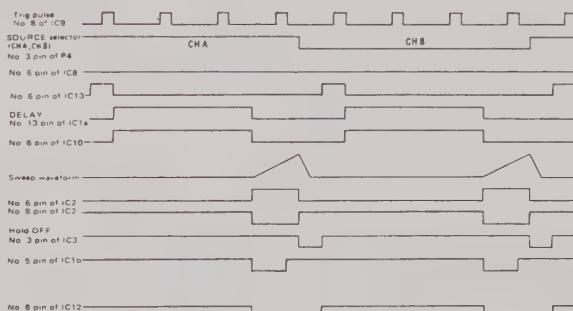


TROUBLESHOOTING

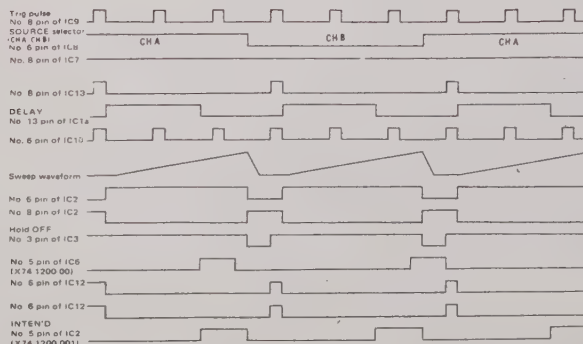
9.



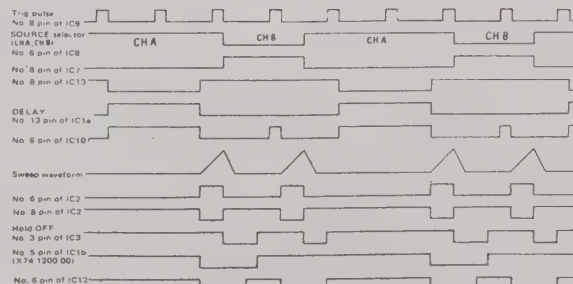
1 CHA DELAY CHB NORM



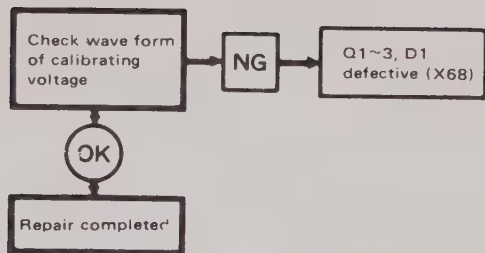
2. CHA DELAY CHB DELAY



3. CHA INTEN'D CHB INTEN'D



10.



PARTS LIST

IMPORTANT

This parts list reflects Model 1525 at the start of production and Model 1530 at serial number 07-05150. When ordering parts for Model 1530 with an earlier serial number, first check the HISTORY OF PRODUCTION CHANGES section at the end of this manual for possible differences.

UNLISTED PARTS

Standard value carbon resistors are not listed. See schematic diagram for value. Unless otherwise specified on schematic, such resistors are $\pm 5\%$, 1/4 W.

U.S.A. PARTS ORDERING INFORMATION

There is a minimum charge for each invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover handling, postage or express charges. Specify model and serial number when ordering replacement parts.

ORDER REPLACEMENT PARTS FROM:

B & K-Precision, Dynascan Corporation
Factory Service Operations
4050 North Ravenswood Avenue
Chicago, Illinois 60613
Tel (312) 327-7270
Telex: 25-3475

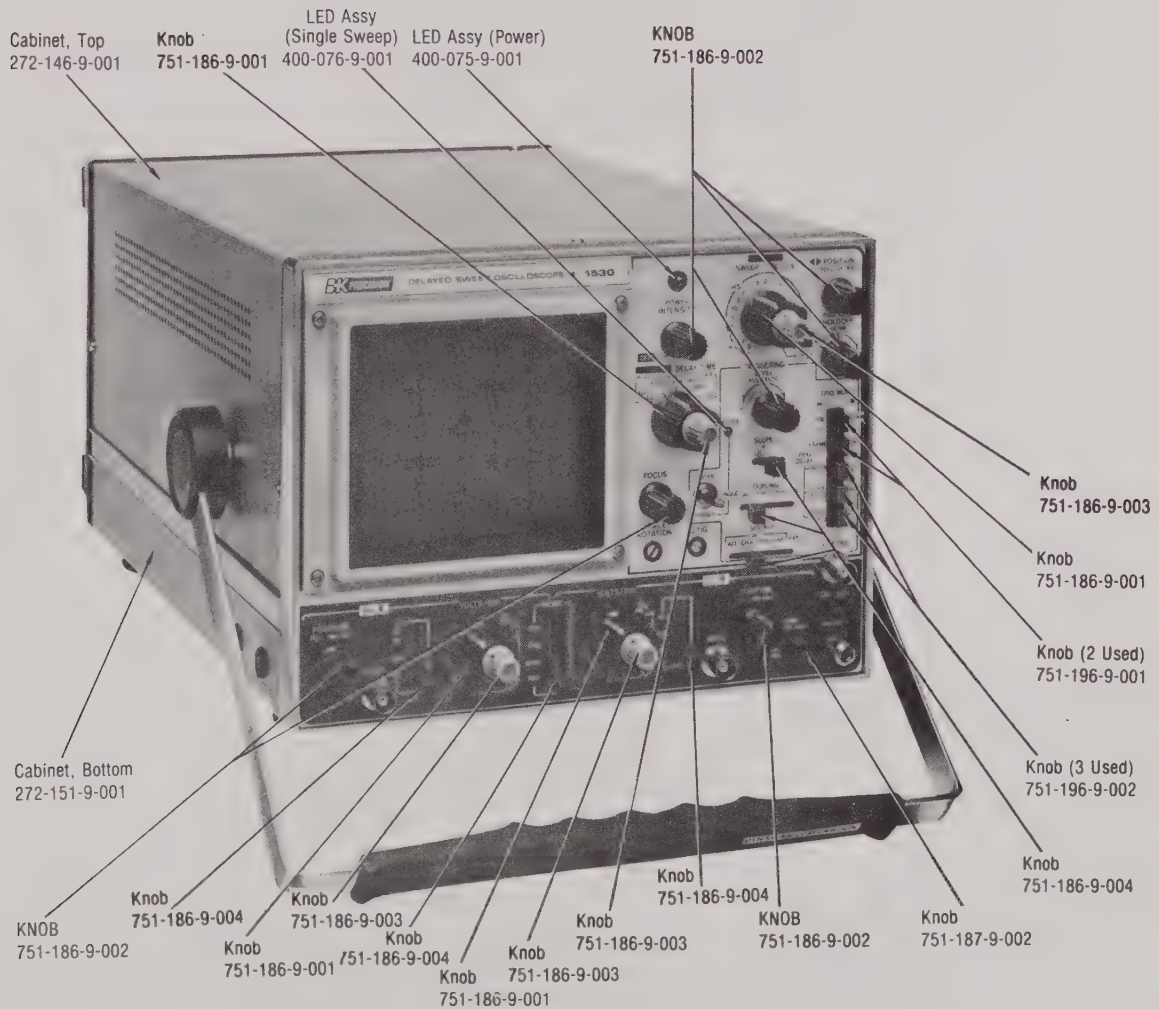


Fig. 33. Knobs and Hardware.

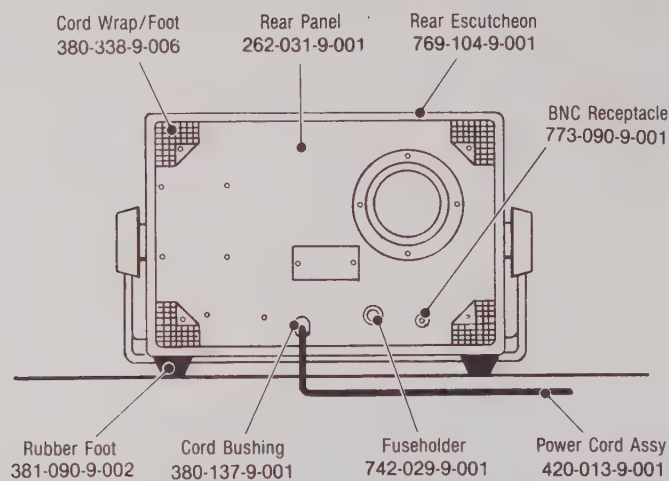


Fig. 34. Rear Panel Parts.

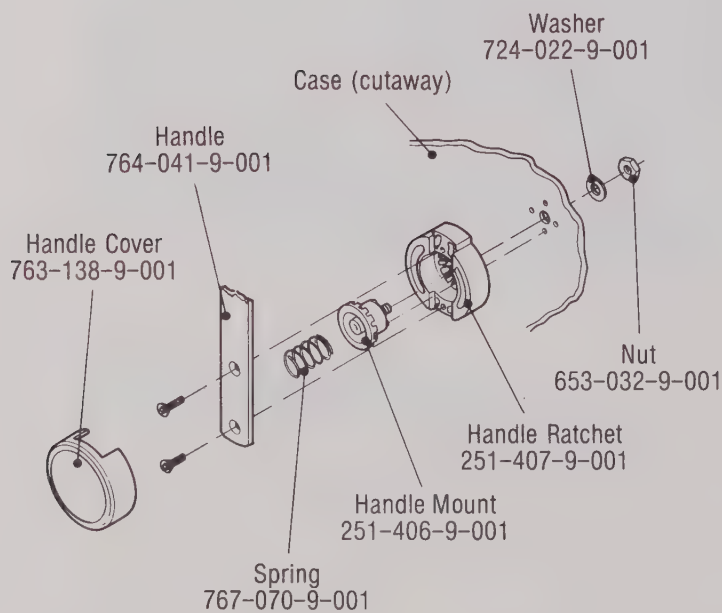
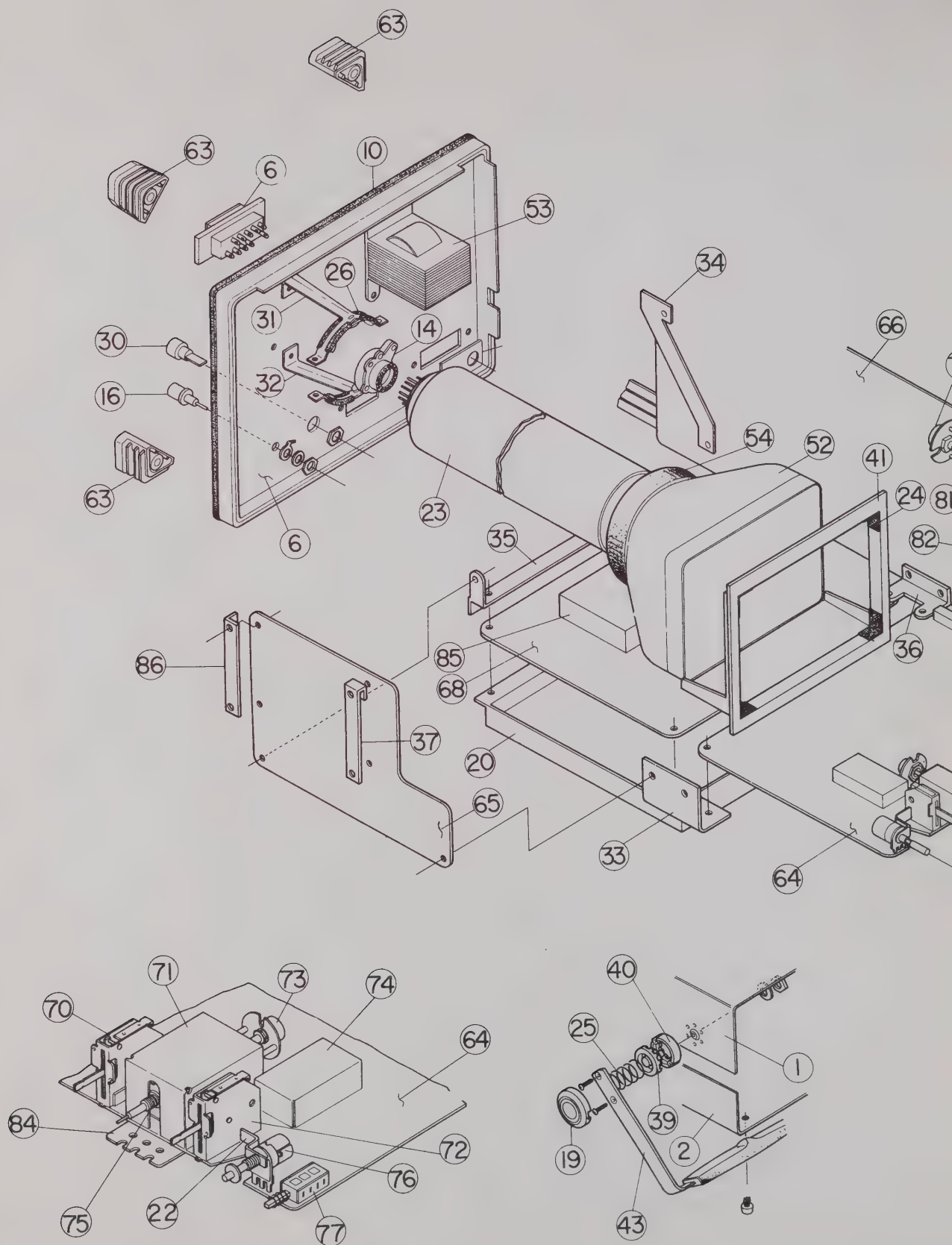


Fig. 35. Handle Parts.



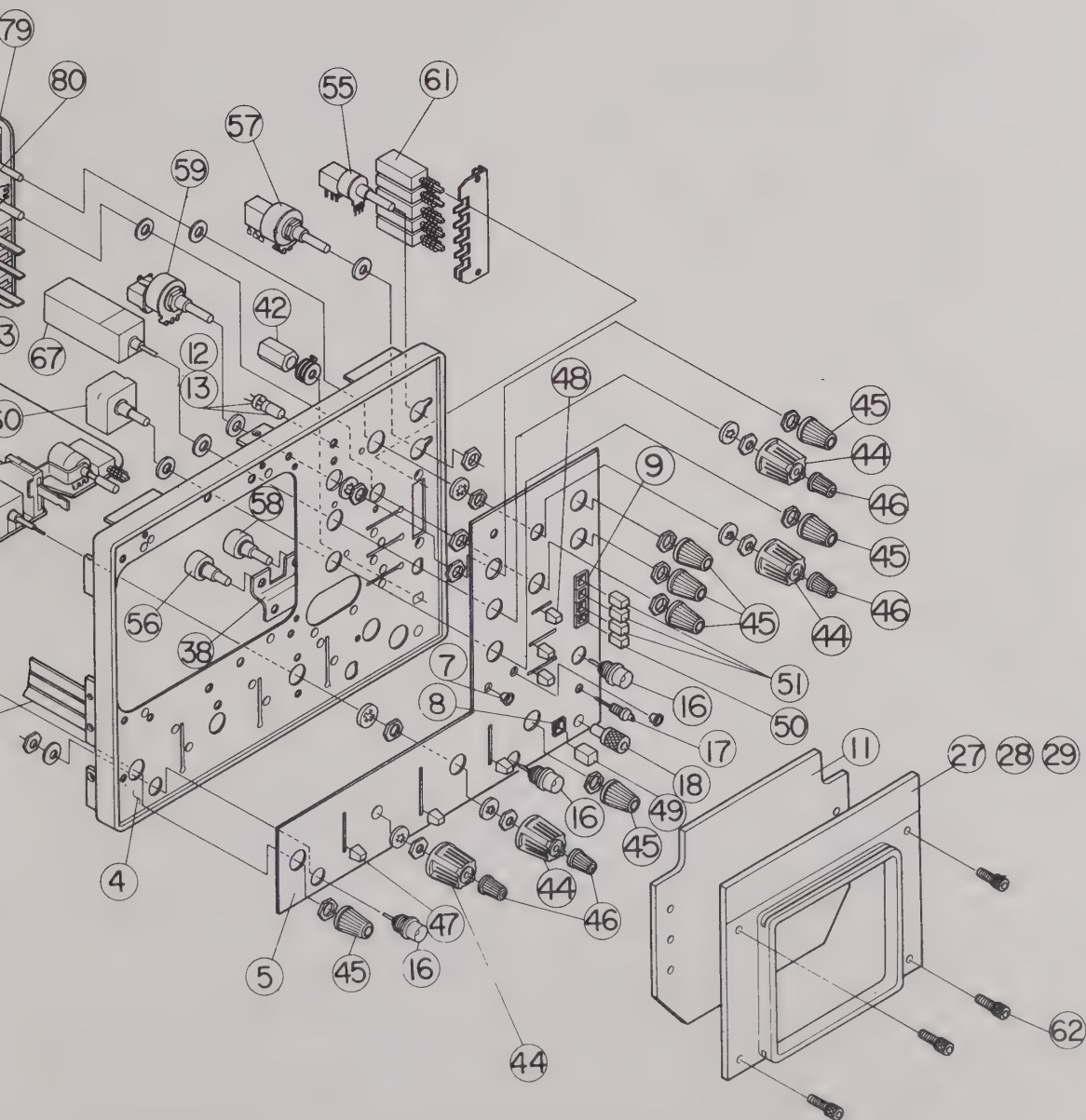


Fig. 36. Exploded View.

PARTS LIST FOR FIG. 36

Unless otherwise stated, replacement parts apply equally
to Model 1525 and 1530

INDEX NUMBER	DESCRIPTION	B & K-PRECISION PART NUMBER
1	Case, Upper	272-146-9-001
2	Case, Lower	272-151-9-001
3	Frame	254-069-9-001
	For earlier 1530's, see HISTORY OF PRODUCTION CHANGES section	
4	Die Cast Panel	255-227-9-001
	For earlier 1530's, see HISTORY OF PRODUCTION CHANGES section	
5	Decorative Panel (Model 1530)	260-235-9-001
5	Decorative Panel (Model 1525)	260-328-9-001
6	Rear Panel	262-031-9-001
7	Push Escutcheon (round grey), Trim Ring for TRACE ROTATION or ASTIG Control	769-103-9-001
8	Push Escutcheon (rectangular grey), Trim Ring for CH B POLARITY Switch	769-103-9-002
9	Push Escutcheon (rectangular grey), Trim Ring for FRAME-LINE, FIX-NORM, INTEN, CH A DLY'D, or CH B DLY'D Switch	769-110-9-001
10	Rear Escutcheon	769-104-9-001
11	Filter (CRT)	380-364-9-003
12	Lamp Assembly (Power)	400-075-9-001
13	LED	400-065-9-001
14	CRT Socket	749-080-9-001
16	BNC Receptacle, CH A and CH B INPUT, EXT TRIG, and Z AXIS INPUT jacks	773-090-9-001
17	CAL Terminal	345-059-9-001
18	Ground Terminal	345-065-9-001
19	Handle Cover	763-138-9-001
20	Shield Plate (power supply)	256-166-9-001
22	Shield Plate (vertical amplifier)	256-166-9-002
23	CRT Shield	256-125-9-001
24	Felt	351-012-9-001
25	Spring, Handle	767-070-9-001
26	CRT Mounting Rubber	381-090-9-001
27	Bezel Assembly	380-364-9-002
28	Bezel	380-364-9-001
29	Bezel Frame	769-102-9-002
30	Fuse Holder	742-029-9-001
31	CRT Band	741-127-9-002
32	CRT Band	741-127-9-001
33	PCB Bracket	251-415-9-001
34	PCB Bracket	251-416-9-001
35	PCB Bracket	251-471-9-001
36	PCB Bracket	251-457-9-001
37	PCB Bracket	251-458-9-001

PARTS LIST FOR FIG. 36
(continued)

INDEX NUMBER	DESCRIPTION	B & K-PRECISION PART NUMBER
38	Variable Resistor Mounting Bracket (for TRACE ROTATION and ASTIG Controls)	251-470-9-001
39	Gear	251-406-9-001
40	Ring	251-407-9-001
41	CRT Mounting Bracket	251-469-9-001
42	Hex Post	759-132-9-001
	For earlier 1530's, see HISTORY OF PRODUCTION CHANGES section	
43	Handle.....	746-041-9-001
44	Knob (for VOLTS/DIV, SWEEP TIME/DIV, or Coarse DELAY TIME Control)	751-186-9-001
45	Knob (for FOCUS, INTENSITY, POSITION, etc. Control).....	751-186-9-002
46	Knob (for VARIABLE or Fine DELAY TIME Control)	751-186-9-003
47	Knob, Lever Switch	751-186-9-004
49	Pushbutton Knob (rectangular grey), for CH B POLARITY Switch	751-187-9-002
50	Pushbutton Knob (rectangular grey), for FRAME-LINE or FIX-NORM Switch.....	751-196-9-001
51	Pushbutton Knob (ocher), for INTEN, CH A DLY'D, or CH B DLY'D Switch	751-196-9-002
52	CRT, 140CGB31	230-020-9-001
53	Power Transformer	665-154-9-001
54	Trace Rotation Coil	041-132-9-001
	For earlier 1530's, see HISTORY OF PRODUCTION CHANGES section	
55	Potentiometer (VR202), H. POSITION	008-226-9-002
56	Potentiometer (VR206), TRACE ROTATION.....	008-267-9-003
57	Potentiometer (VR207), HOLDOFF	008-390-9-003
58	Potentiometer (VR203), ASTIG	008-169-9-003
59	Potentiometer (VR201), INTENSITY.....	008-390-9-003
60	Potentiometer (VR205), FOCUS.....	008-390-9-001
61	Pushbutton Switch Assembly, 5-Station (S203-207) for Model 1530	088-101-9-001
	For earlier 1530's, see HISTORY OF PRODUCTION CHANGES section	
61	Pushbutton Switch Assembly, 4-Station (S204-207) for Model 1525	088-082-9-001
62	Allen Head Screw	634-123-9-001
63	Cord Wrap/Foot	380-338-9-006
64	Vertical Amplifier Board Assembly (for Model 1525 and 1530)	523-307-9-003
65	Vertical Output Amplifier Board Assembly (for Model 1530)	523-486-9-001
	For earlier 1530's, see HISTORY OF PRODUCTION CHANGES section	

PARTS LIST FOR FIG. 36
(continued)

INDEX NUMBER	DESCRIPTION	B & K-PRECISION PART NUMBER
65	Vertical Output Amplifier Board Assembly (for Model 1525)	523-485-9-003
66	Horizontal Sweep Board Assembly (for Model 1530)	523-307-9-006
66	Horizontal Sweep Board Assembly (for Model 1525)	523-485-9-004
67	Sweep Delay Assembly (for Model 1525 and 1530)	523-307-9-005
68	Power Supply Board Assembly (for Model 1530)	523-307-9-002
68	Power Supply Board Assembly (for Model 1525)	523-485-9-002
70	Lever Switch (S106), MODE	080-004-9-002
71	Shield Case (vertical attenuator)	256-119-9-001
72	Lever Switch (S101, 102), AC-GND-DC	080-003-9-001
73	Potentiometer (VR102, 107), CH A and CH B VARIABLE	008-298-9-002
	For earlier 1530's, see HISTORY OF PRODUCTION CHANGES section	
74	Shield Case (vertical amplifier)	256-090-9-001
75	Rotary Switch (S103, 104), VOLTS/DIV	083-266-9-001
	For earlier 1530's, see HISTORY OF PRODUCTION CHANGES section	
76	Potentiometer (VR104, 109), CH A and CH B POSITION	008-390-9-005
77	Pushbutton Switch (S105), CH B POLARITY	088-032-9-001
78	Potentiometer (VR4), Sweep Time VARIABLE	008-298-9-006
79	Rotary Switch (S2), SWEEP TIME/DIV	083-212-9-002
80	Potentiometer (VR8), TRIG LEVEL	008-390-9-006
81	Lever Switch (S5), SLOPE	080-004-9-001
82	Lever Switch (S4), COUPLING	080-004-9-002
83	Lever Switch (S3), SOURCE	080-004-9-002
84	Shield Plate (vertical attenuator)	256-064-9-001
85	Shield Case (power supply)	256-158-9-002
86	PCB Bracket	251-459-9-001

PACKING LIST
(Parts Shown in Fig. 37)

INDEX NUMBER	DESCRIPTION	B & K-PRECISION PART NUMBER
1	Foam Cushion	502-125-9-001
2	Protection Board	502-131-9-001
3	Foam Cushion	502-125-9-001
4	Carton (Model 1530)	500-296-9-001
4	Carton (Model 1525)	500-458-9-001
5	Probe	Model PR-40
6	Plastic Bag	502-132-9-001
7	Instruction Manual (Model 1530)	480-283-9-001
7	Instruction Manual (Model 1525)	480-348-9-001
8	Composite (Model 1530)	499-178-9-001
8	Composite (Model 1525)	499-233-9-001
9	Warranty Card	491-199-9-001
10	Factory Service List	492-036-0-000
11	Spare Fuse, 0.6 A (for 120 VAC)	191-014-9-001
12	Spare Fuse, 0.3 A (for 220 VAC)	191-010-9-001
13	220-240 V Label	483-227-9-001
14	Plastic Bag	502-090-9-001

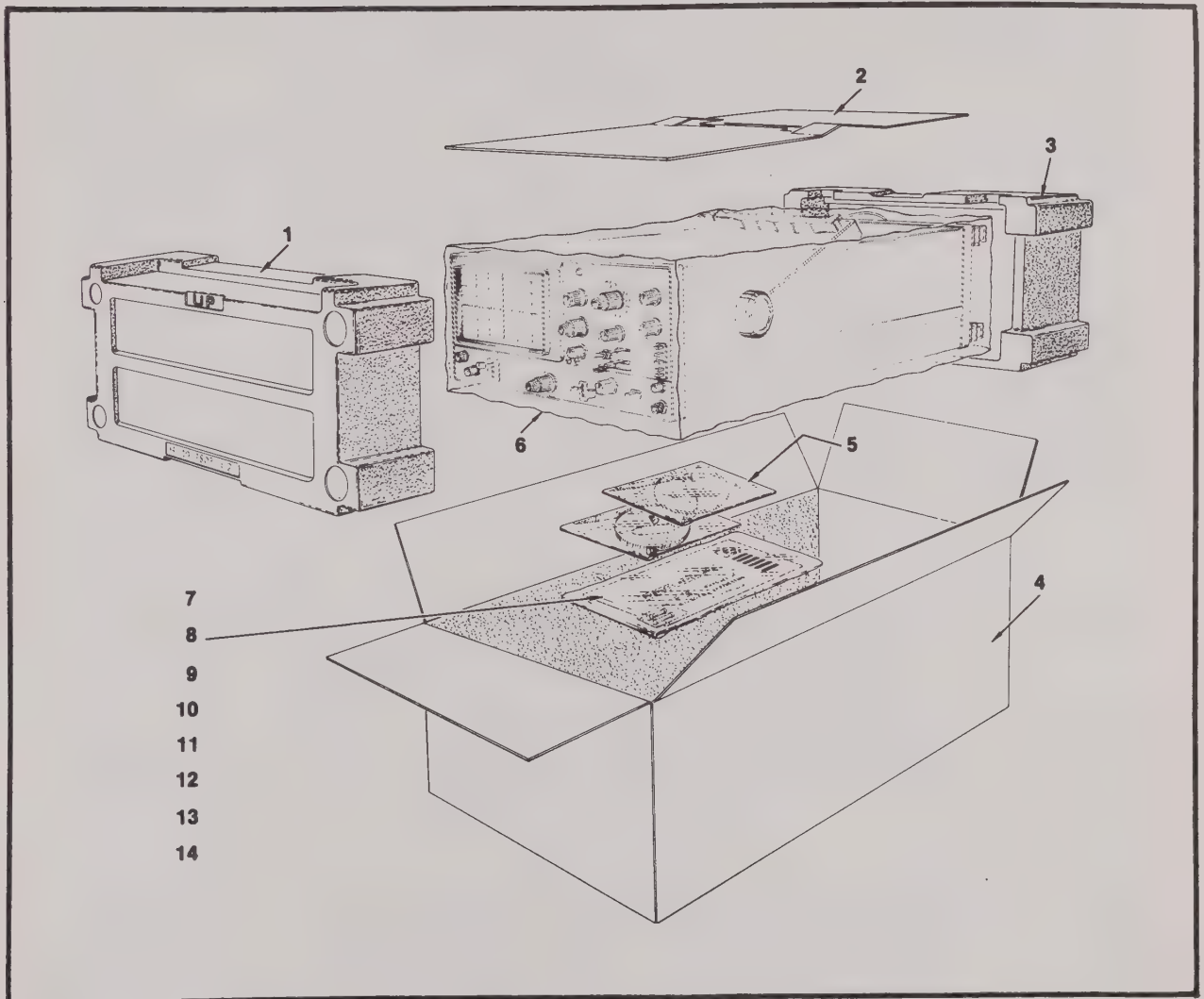


Fig. 37. Packing Drawing.

ELECTRICAL PARTS LIST

Unless otherwise stated, all replacement parts apply equally
to Model 1525 and 1530

MAIN CHASSIS

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
RESISTORS		
VR201/S201	500 Ω Potentiometer with Switch, INTENSITY	008-390-9-002
VR202/S202	5 k Ω Potentiometer with Pull Switch, POSITION/PULL 5X MAG	008-226-9-002
VR203	250 k Ω Potentiometer, ASTIG	008-169-9-003
VR205	2 M Ω Potentiometer, FOCUS	008-437-9-001
VR206	10 k Ω Potentiometer, TRACE ROTATION	008-267-9-003
VR207/S208	1 M Ω Potentiometer with Pull Switch, HOLDOFF/PULL CHOP	008-390-9-003

SWITCHES

S203-207	Pushbutton Switch Assembly, 5-Station, for Model 1530	088-101-9-001
	For earlier 1530's, see HISTORY OF PRODUCTION CHANGES section	
S204-207	Pushbutton Switch Assembly, 4-Station, for Model 1525	088-082-9-001
S209	Toggle Switch, SINGLE (Model 1530 only)	085-004-9-001

CABLES & CONNECTORS

J1	Lead Wire/Connector, 1 pin (CAL)	527-102-9-001
J2	Lead Wire/Connector, 4 pin (HOLDOFF), For Model 1525	527-107-9-001
J2	Lead Wire/connector, 4 pin (HOLDOFF/SINGLE), For Model 1530	527-095-9-006
J3	Lead Wire/Connector, 5 pin (NORM-FIX), Model 1530 only	527-095-9-009
J4	Lead Wire/Connector, 2 pin (CHOP)	527-095-9-005
J7	Lead Wire/Connector, 4 pin (S204-207)	527-095-9-007
J8	Lead Wire/Connector, 7 pin (DELAY)	527-095-9-008
J10	Lead Wire/Connector, 1 pin (H Deflection)	527-095-9-012
J11	Lead Wire/Connector, 3 pin (INTENSITY)	527-095-9-013
J13	Lead Wire/Connector (CRT)	527-095-9-014
J14	Lead Wire/Connector, 1 pin (CRT Shield)	527-069-9-006

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NUMBER
J15	Lead Wire/Connector, 4 pin (Z Axis)	527-090-9-002
J16	Lead Wire/Connector, 3 pin (Rotation Control)	527-095-9-010
J21	Lead Wire/Connector, 1 pin (Line Sync)	527-095-9-004
J22	Lead Wire/Connector, 2 pin	527-095-9-003
	Lead Wire/Connector (V Deflection)	527-107-9-002
	Lead Wire/Connector, 2 pin (Rotator Coil)	527-095-9-001
	3-Wire AC Power Cord Assembly	420-020-9-001

DIODES

D1	1S1555, Silicon Diode	151-028-9-007
J17	LED Assembly, POWER	400-075-9-001
J6	LED Assembly, SINGLE Sweep (Model 1530 only)	400-076-9-001

MISCELLANEOUS

L201, 202	Ferrite Inductor	041-089-9-002
	Fuse, 0.6 A (for 120 VAC)	191-014-9-001
	Fuse, 0.3 A (for 220 VAC)	191-010-9-001
	CRT, 140CGB31	230-020-9-001
	CRT Socket	749-080-9-001
	Power Transformer	065-154-9-001

SCHEMATIC
SYMBOL

DESCRIPTION

B & K-PRECISION
PART NUMBER

SWEEP BOARD

RESISTORS & POTENTIOMETERS

R26	100 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-048-9-005
R27	3 M Ω , 1/4 W, $\pm 1\%$ Metal Film	004-165-9-001
R28	100 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-048-9-005
R29	300 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-017
R30	500 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-012-9-002
R31	1 M Ω , 1/4 W, $\pm 1\%$ Metal Film	013-012-9-003
R68, 69	100 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-008-9-020
R91	4.7 k Ω , 2 W, $\pm 2\%$ Metal Film	013-048-9-006
R92	5.1 k Ω , 2 W, $\pm 2\%$ Metal Film	013-048-9-008
R93	39 k Ω , 1 W, $\pm 5\%$ Metal Film	013-048-9-007
R139, 140	4.7 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-001
VR1	10 k Ω Potentiometer	008-298-9-010
VR2, 3	100 k Ω Potentiometer	008-298-9-013
VR4	5 k Ω Potentiometer, Sweep Time VARIABLE	008-298-9-006
VR5	100 k Ω Potentiometer	008-298-9-013
VR6	4.7 k Ω Potentiometer	008-298-9-009
VR7	47 k Ω Potentiometer	008-298-9-012
VR8/S1	50 k Ω Potentiometer with Switch, (LEVEL/PULL AUTO) .	008-390-9-006
VR10	10 k Ω Potentiometer	008-298-9-010
VR11	1 k Ω Potentiometer	008-390-9-007
VR12	100 k Ω Potentiometer	008-298-9-001
VR13	100 k Ω Potentiometer	008-298-9-001
VR14	100 k Ω Potentiometer	008-298-9-001
VR15	22 k Ω Potentiometer	008-298-9-011
VR17, 18	1 k Ω Potentiometer	008-390-9-007
VR19	15 k Ω Potentiometer	008-379-9-001
VR20	4.7 k Ω Potentiometer	008-298-9-009

CAPACITORS

C1, 2	6800 pF, $\pm 10\%$, 50 V Mylar	025-136-9-004
C3	100 μ F, 10 V Electrolytic	022-123-9-002
C4, 5, 6	1 μ F, 50 V Electrolytic	022-086-9-004
C7, 8	.01 μ F, $\pm 20\%$, 50 V Ceramic	020-250-9-008
C9	33 pF, $\pm 5\%$, 50 V Ceramic	020-238-9-001
C10	0.47 μ F $\pm 1\%$ 50 V Ceramic	025-107-9-003
C11	0.0047 μ F $\pm 1\%$ 50 V Ceramic	025-107-9-004
C12	33 pF, $\pm 5\%$, 50 V Ceramic	020-238-9-001
C13	10 pF, $\pm 0.5\%$, 50 V Ceramic	020-215-9-001
C14	0.33 μ F, $\pm 20\%$, 35 V Tantalum	027-051-9-001
C15	.033 μ F, $\pm 10\%$, 50 V Mylar	025-056-9-004
C16	1000 pF, $\pm 20\%$, 50 V Ceramic	020-250-9-006
C17	0.1 μ F, 12 V Ceramic	033-018-9-001
C18	18 pF, $\pm 5\%$, 50 V Ceramic	020-149-9-002
C19, 20	1500 pF, $\pm 10\%$, 50 V Mylar	025-107-9-005
C21	680 pF, $\pm 10\%$, 50 V Ceramic	020-200-9-003

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NUMBER
C22	150 pF, $\pm 5\%$, 50 V Ceramic	020-171-9-003
C23	10 pF, ± 0.5 pF, 500v Ceramic	020-306-9-002
C24	.015 μ F, $\pm 10\%$, 50 V Mylar	025-161-9-001
C25	100 pF, $\pm 5\%$, 500 V Ceramic	020-171-9-007
C26	15 pF, $\pm 5\%$, 50 V Ceramic	020-250-9-005
C27	3300 pF, $\pm 20\%$, 500 V Ceramic	020-149-9-004
C28, 29	1 μ F, $\pm 20\%$, 50 V Electrolytic, Non-Polarized (Model 1530 only)	022-167-9-001
C30	15 pF $\pm 5\%$, 50 V Ceramic	020-250-9-005
C31-34	.01 μ F, $\pm 20\%$, 50 V Ceramic	020-250-9-008
C35	15 pF, $\pm 5\%$, 50 V Ceramic	020-250-9-005
C37	5 pF ± 0.25 pF, 50 V Ceramic	020-238-9-001
C38	1000 pF, $\pm 20\%$, 500 V Ceramic	020-171-9-010
C39	100 μ F, 10 V Electrolytic	022-123-9-002
C40, 41	470 μ F, 16 V Electrolytic	022-073-9-003
C42	2200 pF, $\pm 20\%$, 50 V Ceramic	020-250-9-007
C43	47 μ F, 10 V Electrolytic	022-119-9-004
C44	0.1 μ F, 12 V Ceramic	033-018-9-001
C45	47 pF, $\pm 5\%$, 50 V Ceramic	020-144-9-004
C46	.01 μ F, $\pm 20\%$, 50 V Ceramic	020-250-9-008
C48	10 pF, ± 0.5 pF, 50 V Ceramic	020-144-9-007
C49	220 pF, $\pm 5\%$, 50 V Ceramic	020-124-9-008
C51	.01 μ F, $\pm 20\%$, 50 V Ceramic	020-250-9-008
C52-56	0.1 μ F, 12 V Ceramic	033-018-9-001
C57	220 pF, $\pm 5\%$, 50 V Ceramic	020-124-9-008
C58	5 pF ± 0.5 pF, 50 V Ceramic	020-144-9-008
C59	220 pF, $\pm 5\%$, 50 V Ceramic	020-124-9-008
C60	0.1 μ F, 12 V Ceramic	033-018-9-001
C61, 62	2 pF ± 0.5 pF, 50 V Ceramic	020-250-9-004
C63	1 μ F, $\pm 20\%$, 50 V Electrolytic, Non-Polarized	022-167-9-001
C64	100 μ F, 10 V Electrolytic	022-123-9-002
C65	2200 pF, $\pm 10\%$, 50 V Mylar	025-107-9-006
C77-80	.01 μ F, $\pm 20\%$, 50 V Ceramic	020-296-9-001
C81-84	0.1 μ F, 12 V Ceramic	033-018-9-001
C87	47 μ F, 10 V Electrolytic	022-119-9-004
C88	220 μ F, 10 V Electrolytic	022-126-9-001
C89	150 pF, $\pm 5\%$, 50 V Ceramic	020-171-9-003
C90	1500 pF, $\pm 20\%$, 50 V Ceramic	020-250-9-009
C91	470 pF $\pm 5\%$, 50 V Ceramic	020-171-9-008
C92	1 μ F, $\pm 20\%$, 50 V Electrolytic, Non-Polarized	022-167-9-001
C93	470 pF $\pm 10\%$, 50 V Ceramic	020-171-9-008
C94, 95, 96	.01 μ F, $\pm 20\%$, 50 V Ceramic	020-296-9-001
TC1	20 pF Trimmer	028-050-9-002
TC2	10 pF Trimmer	028-050-9-003
TC3, 4	6 pF Trimmer	028-050-9-001

DIODES

D1	1N60 Germanium Diode	150-001-9-005
D2-4	1S1555 Silicon Diode	151-028-9-007
D5	1N60 Germanium Diode	150-001-9-005
D6	1S1587 Silicon Diode	151-048-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NUMBER
D7-10	1S1555 Silicon Diode.....	151-028-9-007
D11	1N60 Germanium Diode	150-001-9-005
D15	1S1555 Silicon Diode.....	151-028-9-007
D16	YZ-030 Zener Diode, 3.0 V	152-099-9-002
D17-20	1S1555 Silicon Diode.....	151-028-9-007
D22, 23	1S1555 Silicon Diode.....	151-028-9-007
D26	1S1555 Silicon Diode.....	151-028-9-007
D28, 29	1S1555 Silicon Diode.....	151-028-9-007
D30	1N60 Germanium Diode	150-001-9-005
D32-40	1S1555 Silicon Diode.....	151-028-9-007

TRANSISTORS

Q1-6	2SC945-P NPN Silicon Signal Transistor	176-055-9-002
Q7, 8	2SA733-Q PNP Silicon Signal Transistor	177-018-9-001
Q9	2SC945-P NPN Silicon Signal Transistor	176-055-9-002
Q10	2SK30A-0 FET, N-Channel	182-026-9-001
Q11	2SC945-P NPN Silicon Signal Transistor	176-055-9-002
Q12	2SK30A-0 FET, N-Channel	182-026-9-001
Q13	2SC945-P NPN Silicon Signal Transistor	176-055-9-002
Q14	2SK185-2-M Dual FET	182-058-9-001
Q15	2SK30A-0 FET, N-Channel	182-026-9-001
Q16-19	2SC945-P NPN Silicon Signal Transistor	176-055-9-002
Q20	2SC535-C NPN Silicon Signal Transistor.....	176-055-9-001
Q21, 22	2SC945-P NPN Silicon Signal Transistor	176-055-9-002
Q23, 24	2SC1507 NPN Silicon Signal Transistor	176-055-9-006
Q25-29	2SC945-P NPN Silicon Signal Transistor	176-055-9-002
Q31	2SC945-P NPN Silicon Signal Transistor	176-055-9-002
Q32	2SC945-P NPN Silicon Signal Transistor (Model 1530 only)	176-055-9-002
Q33	2SC945-P NPN Silicon Signal Transistor (Model 1530 only)	176-055-9-002
Q34	2SA733-Q PNP Silicon Signal Transistor (Model 1530 only)	177-018-9-001

INTEGRATED CIRCUITS

IC1	SN74H00N Digital IC	307-106-9-002
IC2	SN74H72N Digital IC	307-106-9-003
IC3	NJM555D Linear IC	307-171-9-001
IC4	SN7400N Digital IC	307-106-9-004
IC5	RC733T Linear IC	307-069-9-001
IC6-10, 12	SN74LS00N Digital IC.....	307-139-9-002
IC13	SN74H72N Digital IC	307-106-9-003

INDUCTORS

L2	47 μ H Inductor	041-068-9-002
L3	3.9 μ H Inductor	041-122-9-001
L4, 5	150 μ H Inductor	041-082-9-003
L6-8	47 μ H Inductor	041-068-9-002
L9	100 μ H Inductor	041-124-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NUMBER
L10	330 μ H Inductor	041-113-9-001
L11	150 μ H Inductor	041-082-9-003

SWITCHES

S2	Rotary Switch, SWEEP TIME/DIV	083-212-9-002
S3	Lever Switch, 5-position, SOURCE	080-014-9-001
S4	Lever Switch, 4-position, COUPLING	080-004-9-002
S5	Lever Switch, 2-position, SLOPE	080-004-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NUMBER
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DELAY TIME BOARD

RESISTORS & POTENTIOMETERS

R6	4.7 k Ω , $\pm 1\%$, 1/4 W, Metal Film	013-013-9-001
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CAPACITORS

C1	3.3 μ F, 10 V Electrolytic	022-212-9-002
C2	0.33 μ F, 10 V Film	033-061-9-001
C3	.033 μ F, $\pm 10\%$, 50 V Mylar	025-056-9-004
C4	3300 pF, $\pm 10\%$, 50 V Mylar	025-136-9-003
C5	220 pF, $\pm 5\%$, 50 V Ceramic	020-124-9-008
C6	100 pF, $\pm 5\%$, 50 V Ceramic	020-096-9-006
C7	47 μ F 10V Electrolytic	011-119-9-004
C8	0.01 μ F $\pm 20\%$, 50 V Ceramic	020-142-9-012

SEMICONDUCTORS

D1-4	1S1555 Silicon Diode	151-028-9-007
IC1	SN74LS123N Digital IC	307-198-9-002
IC2	SN74H72N Digital IC	307-106-9-003

MISCELLANEOUS

L1	47 μ H Inductor	041-068-9-002
S1/VR1	Rotary Switch with Dual Potentiometer, 20 k Ω and 100 k Ω , DELAY TIME Control	083-285-9-001

SCHEMATIC
SYMBOL

DESCRIPTION

B & K-PRECISION
PART NO.

VERTICAL AMPLIFIER BOARD

RESISTORS & POTENTIOMETERS

R102	900 k Ω , 1/2 W, $\pm 1\%$ Metal Film	013-034-9-044
R103	111 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-010-9-010
R104	990 k Ω , 1/2 W, $\pm 1\%$ Metal Film	013-034-9-045
R105	10.1 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-010-9-008
R106	4.02 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-012
R107	1 M Ω , 1/2 W, $\pm 1\%$ Metal Film	013-008-9-023
R117, 118	3.9 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-012-9-011
R120	2.7 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-010
R121	3.3 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-045-9-002
R122	2.2 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-009
R124	130 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-007
R126	69.8 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-048-9-004
R127-129	100 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-006
R130	10 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-004
R135	150 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-015
R139, 140	3.9 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-012-9-011
R141	120 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-010-9-001
R155, 156,	560 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-008
R162	900 k Ω , 1/2 W, $\pm 1\%$ Metal Film	013-034-9-044
R163	111 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-010-9-010
R164	990 k Ω , 1/2 W, $\pm 1\%$ Metal Film	013-034-9-045
R165	10.1 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-010-9-008
R166	4.02 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-012
R167	1 M Ω , 1/2 W, $\pm 1\%$ Metal Film	013-008-9-023
R177, 178	3.9 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-012-9-011
R180	2.7 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-010
R181	3.3 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-045-9-002
R182	2.2 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-009
R184	130 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-007
R186	69.8 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-048-9-004
R187-189	100 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-006
R190	10 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-004
R195	150 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-015
R199, 200	3.9 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-012-9-011
R215, 216	560 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-008
R224, 225	270 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-010-9-014
R226, 227	91 Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-003
R229	2.2 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-009
R230	2.2 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-013-9-009
R233, 234	2 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-012-9-010
R239, 240	996 k Ω , 1/2 W, $\pm 1\%$ Metal Film	011-124-9-001
R241, 242	53 Ω 1/2 W $\pm 1\%$ Metal Film	013-068-9-002
R245-248	10 Ω $\pm 1\%$ Metal Film	013-013-9-004
VR101	330 Ω Potentiometer	008-347-9-002
VR102	300 Ω Potentiometer, "VARIABLE"	008-298-9-002
VR103	100 Ω Potentiometer	008-298-9-004

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
VR104	1 k Ω Potentiometer, "POSITION"	008-390-9-005
VR105	2.2 k Ω Potentiometer	008-169-9-007
VR106	330 Ω Potentiometer	008-437-9-002
VR107	300 Ω Potentiometer, "VARIABLE"	008-298-9-002
VR108	100 Ω Potentiometer	008-298-9-004
VR109	1 k Ω Potentiometer, "POSITION"	008-390-9-005
VR110, 111	100 Ω Potentiometer	008-298-9-001
VR112	2.2 k Ω Potentiometer	008-169-9-007
VR113	6.8 k Ω Potentiometer	008-382-9-002
VR117, 118	100 Ω Potentiometer	008-298-9-001
TH101, 102	Thermistor STD-1000	005-003-9-002

CAPACITORS

C101	0.047 μ F, $\pm 10\%$, 630 V Metal Film	033-023-9-001
C103	47 pF, ± 0.25 pF 100 V Mica	023-056-9-002
C104	2 pF, ± 0.5 pF, 500 V Ceramic	020-171-9-003
C105	150 pF, $\pm 5\%$, 100 V Mica	023-061-9-001
C106	0.01 μ F, $\pm 10\%$, 630 V Metal Film	033-023-9-002
C107, 108	0.1 μ F, 12 V Metal Film	033-018-9-001
C110, 112	100 μ F, 10 V Electrolytic	022-123-9-002
C114	0.047 μ F, $\pm 10\%$, 630 V Metal Film	033-023-9-001
C115	0.01 μ F, $\pm 10\%$, 630 V Metal Film	033-023-9-002
C117	47 pF, $\pm 5\%$ 100 V Mica	023-056-9-002
C118	2 pF, ± 0.25 pF, 500 V Ceramic	020-171-9-003
C119	150 pF, $\pm 5\%$, 100 V Mica	023-061-9-001
C120-121	0.1 μ F, 12 V Metal Film	033-018-9-001
C123-126	100 μ F, 10 V Electrolytic	022-123-9-002
C127	0.1 μ F, 12 V Metal Film	033-018-9-001
C128	220 μ F, 16 V Electrolytic	022-126-9-001
C129, 130	0.1 μ F, 12 V Metal Film	033-018-9-001
C131	100 μ F, 10 V Electrolytic	022-123-9-002
C132	15 pF $\pm 5\%$, 50 V Ceramic	020-142-9-009
C133	22 pF $\pm 5\%$, 50 V Ceramic	020-215-9-002
C135	0.1 μ F, 12 V Metal Film	033-018-9-001
C136, 141	120 pF $\pm 5\%$, 50 V Ceramic	020-167-9-003
C137	15 pF $\pm 5\%$, 50 V Ceramic	020-142-9-009
C138	22 pF $\pm 5\%$, 50 V Ceramic	020-215-9-002
C140	5 pF ± 0.5 pF, 50 V Ceramic	020-144-9-008
C142, 143	0.01 μ F, 50 V Ceramic	020-142-9-012
C144	0.1 μ F, 12 V Metal Film	033-018-9-001
C145	0.01 μ F, 50 V Ceramic	020-142-9-012
C146	0.01 μ F, 50 V Ceramic	020-142-9-012
C147	0.1 μ F, 12 V Metal Film	033-018-9-001
C148	330 pF $\pm 5\%$, 100 V Mica	023-061-9-002
C149, 150	2 pF, ± 0.5 pF, 500 V Ceramic	020-171-9-003
C151	330 pF $\pm 5\%$, 100 V Mica	023-061-9-002
C154	22 pF $\pm 5\%$, 50 V Ceramic	020-215-9-002
C155	15 pF $\pm 5\%$, 50 V Ceramic	020-142-9-009
C156-159	10 pF ± 0.5 pF, 50 V Ceramic	020-142-9-003
C160-161	33 pF $\pm 5\%$, 50 V Ceramic	020-149-9-005

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
TC101	6 pF Trimmer	028-033-9-001
TC102	10 pF Trimmer	028-033-9-002
TC103	6 pF Trimmer	028-033-9-001
TC104	10 pF Trimmer	028-033-9-002
TC105, 106	6 pF Trimmer	028-033-9-001
TC107	10 pF Trimmer	028-033-9-002
TC108	6 pF Trimmer	028-033-9-001
TC109	10 pF Trimmer	028-033-9-002
TC110	6 pF Trimmer	028-033-9-001
TC111, 112	10 pF Trimmer	028-033-9-002
TC113	20 pF Trimmer	028-039-9-001

DIODES

D101-108	1S1587 Silicon Diode	151-048-9-001
D109	1S1555 Silicon Diode	151-028-9-007
D111-114	1S1555 Silicon Diode	151-028-9-007
D116, 117	1S1555 Silicon Diode	151-028-9-007
D119-121	1S1555 Silicon Diode	151-028-9-007
D122, 123	1S1587 Silicon Diode	151-048-9-001
D124-127	1N60 Germanium Diode	150-001-9-005

TRANSISTORS

Q101	2SK30A-0 FET	182-026-9-001
Q102	2SK228T-2 or 2SK228T-3 Dual FET	182-061-9-001
Q103-106	2SC535-B NPN Silicon Signal Transistor	176-036-9-001
Q107, 108	2SA838-C PNP Silicon Signal Transistor	177-036-9-001
Q109, 110	2SC535-B NPN Silicon Signal Transistor	176-036-9-001
Q111	2SK30A-0 FET	182-026-9-001
Q112	2SK228T-2 or 2SK228T-3 Dual FET	182-061-9-001
Q113-116	2SC535-B NPN Silicon Signal Transistor	176-036-9-001
Q117, 118	2SA838-C PNP Silicon Signal Transistor	177-036-9-001
Q119-122	2SC535-B NPN Silicon Signal Transistor	176-036-9-001
Q123, 124	2SA844-D PNP Silicon Signal Transistor	177-021-9-001
Q127	2SA844-D PNP Silicon Signal Transistor	177-021-9-001
Q125, 126	2SC458-C NPN Silicon Signal Transistor	176-016-9-001

INTEGRATED CIRCUITS

IC101, 102	HA1127 Linear IC	307-106-9-001
IC103	TD3400AP Digital IC	307-069-9-004
IC104	TD3472AP Digital IC	307-069-9-003

INDUCTORS & SWITCHES

L101, 102	22 μ H Ferri-Inductor	041-068-9-004
S101, 102	Lever Switch, "AC-GND-DC"	080-003-9-001
S103, 104	Rotary Switch, "VOLTS/DIV"	083-266-9-001
S105	Pushbutton Switch, "CH B POLARITY"	088-032-9-001
S106	Lever Switch, "MODE"	080-004-9-002

SCHEMATIC
SYMBOL

DESCRIPTION

B & K-PRECISION
PART NUMBER

POWER SUPPLY BOARD

RESISTORS & CONTROLS

R302	12 M Ω , 1 W, $\pm 5\%$ Metal Film	013-034-9-005
R303	3.3 M Ω , 1/2 W, $\pm 5\%$ Metal Film	002-102-5-335
R304, 305	22 M Ω , 1/2 W, $\pm 10\%$ Metal Film	002-102-6-226
R315	130 k Ω , 1/4 W, $\pm 1\%$ Metal Film	013-048-9-001
R338	4.3 k Ω , 1/4 W $\pm 1\%$ Metal Film	013-034-9-040
R339	8.2 k Ω , 1/4 W $\pm 1\%$ Metal Film	013-010-9-007
R341	15 k Ω , 1/4 W $\pm 1\%$ Metal Film	013-013-9-024
R342	12 k Ω , 1/4 W $\pm 1\%$ Metal Film	013-013-9-023
R344	6.8 k Ω , 1/4 W $\pm 1\%$ Metal Film	013-010-9-006
R348	91 k Ω , 1/4 W $\pm 1\%$ Metal Film	013-013-9-025
R353	510 Ω , 2 W, $\pm 5\%$ Metal Film	013-048-9-002
R365	7.5 M Ω , 1 W Metal Film	004-197-9-001
VR302	47 k Ω Potentiometer	008-169-9-008
VR303	47 k Ω Potentiometer	008-298-9-012
VR304	1 k Ω Potentiometer	008-169-9-006

CAPACITORS

C304	1000 pF, +100/-0%, 2000 V Ceramic	020-163-9-005
C305-308	.01 μ F, +100/-0%, 2000 V Ceramic	020-124-9-011
C309	0.01 μ F, +80/-20%, 50 V Ceramic	020-245-9-001
C310	470 μ F, 50 V Electrolytic	022-135-9-003
C311	0.015 μ F $\pm 10\%$, 50 V Mylar	025-161-9-001
C312	0.1 μ F, 12 V Metal Film	033-018-9-001
C313	3.3 μ F, 250 V Electrolytic	021-061-9-003
C314	220 pF $\pm 5\%$, 50 V Ceramic	020-124-9-008
C315	2 pF ± 0.5 pF, 500 V Ceramic	020-171-9-003
C316	0.1 μ F, 12 V Metal Film	033-018-9-001
C317	10 pF ± 0.5 pF, 50 V Ceramic	020-142-9-003
C318	3300 pF $\pm 20\%$, 500 V Ceramic	020-149-9-004
C319-321	0.01 μ F $\pm 20\%$, 500 V Ceramic	020-111-9-002
C322	0.1 μ F, 12 V Metal Film	033-018-9-001
C323	330 μ F, 10 V Electrolytic	022-149-9-001
C324	0.1 μ F, 12 V Metal Film	033-018-9-001
C325	220 μ F, 16 V Electrolytic	022-086-9-002
C326	3300 μ F, 25 V Electrolytic	022-149-9-003
C327	2200 μ F, 25 V Electrolytic	022-149-9-002
C328	100 μ F, 25 V Electrolytic	022-123-9-001
C329	100 μ F, 50 V Electrolytic	022-073-9-007
C330	330 μ F, 10 V Electrolytic	022-149-9-001
C331	0.1 μ F, 12 V Metal Film	033-018-9-001
C332, 333	0.01 μ F $\pm 20\%$, 500 V Ceramic	020-111-9-002
C334	10 μ F, 160 V Electrolytic	021-061-9-001
C335	100 μ F, 160 V Electrolytic	021-061-9-002
C336	33 μ F, 25 V Electrolytic	022-135-9-001
C337	10 μ F, 160 V Electrolytic	021-061-9-001
C338	.01 μ F, +100/-0%, 2000 V Ceramic	020-124-9-011

SCHEMATIC
SYMBOL

DESCRIPTION

B & K-PRECISION
PART NUMBER

C339, 340	0.1 μ F, 12 V Metal Film	033-018-9-001
C341, 342	10 μ F, 25 V Electrolytic	022-086-9-005
C344	0.01 μ F $\pm$ 20%, 500 V Ceramic	020-111-9-002
TC301	20 pF, Trimmer	028-039-9-001

DIODES

D301	Y16JA High Voltage Silicon Diode	151-048-9-003
D302	HV Silicon Rectifier Network	157-011-9-002
D304-306	1S2463 Silicon Diode	151-061-9-001
D307	1SS83 High Voltage Silicon Diode	151-084-9-001
D308-315	1S1555 Silicon Diode	151-028-9-007
D316	WZ050 Zener Diode, 5.0 V	152-069-9-001
D317	WZ075, Zener Diode, 7.5 V	152-076-9-003
D318	WZ150, Zener Diode, 15 V	152-099-9-003
D319	Bridge Rectifier	157-012-9-001
D320	1SQB60 Bridge Rectifier	157-006-9-001
D321, 322	1S1555 Silicon Diode	151-028-9-007

TRANSISTORS

Q301	2SD401-A-K NPN Silicon Power Transistor	172-057-9-001
Q302	2SC983-Y or 2SC2229-Y NPN Silicon Signal Transistor ..	176-053-9-002
Q303	2SC945-P NPN Silicon Signal Transistor	176-055-9-002
Q304	2CS1628-Y NPN Silicon Signal Transistor	176-055-9-005
Q305	2SA818-Y PNP Silicon Signal Transistor	177-018-9-003
Q306	2SC535-B NPN Silicon Signal Transistor	176-036-9-001
Q307, 308	2SC1419-C NPN Silicon Signal Transistor	176-055-9-004
Q309	2SA755-C or 2SB633-E PNP Silicon Signal Transistor ...	177-018-9-002
Q310	2SB546-A PNP Silicon Signal Transistor	173-008-9-001
Q312-316	2SC945-P NPN Silicon Signal Transistor	176-055-9-002
Q317	2SC1384 NPN Silicon Signal Transistor	176-109-9-001
Q318	2SA684 PNP Silicon Signal Transistor	177-046-9-001

INTEGRATED CIRCUITS

IC301	NJM455-T Linear IC	307-198-9-001
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MISCELLANEOUS

F301	Fuse, 0.5 A (5 mm x 20 mm)	191-015-9-001
L301	470 μ H Ferri-Inductor	041-071-9-001
L302	3.3 μ H Ferri-Inductor	041-082-9-004
N301-303	Neon Lamp, NE-2	401-018-9-001
T301	Transformer, Converter	064-025-9-001
TH301	Thermistor, SDT-1000	005-003-9-002

SCHEMATIC
SYMBOL

DESCRIPTION

B & K-PRECISION
PART NUMBER

AUTO-FOCUS BOARD
(Part of Power Supply Assembly)

RESISTORS

R1	1.1 k Ω $\pm$ 1%, 1/4 W Metal Film	011-104-3-112
R7	9.1 k Ω $\pm$ 1%, 1/4 W Metal Film	011-104-3-912
R8	51 k Ω $\pm$ 1%, 1/4 W Metal Film	011-104-3-513
R9	75 K Ω $\pm$ 1%, 1/4 W Metal Film	013-013-9-002
R13	47 M Ω $\pm$ 5%, 1/2 W Metal Film	004-181-9-002

CAPACITORS

C1	0.01 μ F $\pm$ 20%, 500 V Ceramic	020-111-9-002
C2	0.01 μ F $\pm$ 20%, 50 V Ceramic	020-306-9-001
C3	1 pF $\pm$ 0.25 pF, 500 V Ceramic	020-142-9-008
C4, 5, 6	0.01 μ F +100/-0%, 2 kV Ceramic	020-124-9-001

DIODES

D1	WZ-050 Zener Diode, 5.0 V	152-069-9-001
D3	1S1555 Silicon Diode	151-028-9-007
D4, 5	W06C Diode	151-052-9-002
D6	1SS83 High Voltage Silicon Diode	151-084-9-001

TRANSISTORS

Q1	2SA896-2-2 or 2SA1208-S PNP Silicon Transistor	177-048-9-002
Q2	2SC1811-2-2 or 2SC2910-S NPN Silicon Transistor	176-114-9-004
Q3	2SC1360 NPN Silicon Transistor	176-098-9-001
Q4	2CS983-Y NPN Silicon Transistor	176-053-9-002

SCHEMATIC
SYMBOL

DESCRIPTION

B & K-PRECISION
PART NUMBER

VERTICAL OUTPUT AMPLIFIER BOARD

RESISTORS & POTENTIOMETERS

R401, 402	91 Ω $\pm 1\%$, 1/4 W Metal Film	013-013-9-003
R422, 423	4.7 k Ω $\pm 1\%$, 1/4 W Metal Film	013-013-9-001
R428, 429	75 k Ω $\pm 1\%$, 1/4 W Metal Film	013-013-9-002
VR401	220 Ω Potentiometer	008-382-9-001
VR402	47 k Ω Potentiometer	008-169-9-008
VR403	1 k Ω Potentiometer (Model 1530 only)	008-169-9-006
VR404	220 k Ω Potentiometer	008-155-9-007
VR405	1 k Ω Potentiometer	008-169-9-006

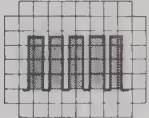
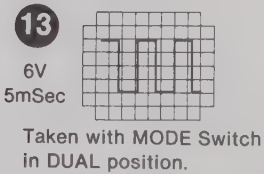
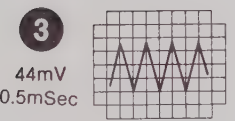
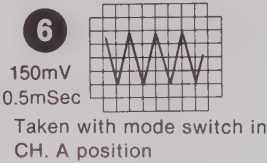
CAPACITORS & TRIMMERS

C40	1 pF ± 0.25 pF, 50 V Ceramic	020-250-9-001
C41	3 pF ± 0.25 pF, 50 V Ceramic	020-233-9-001
C401, 402	0.1 μ F, 12 V Semiconductor Ceramic	033-018-9-001
C403	330 μ F, 10 V Electrolytic	022-238-9-001
C405	10 pF ± 0.5 pF, 50 V Ceramic	020-142-9-003
C406	.033 μ F $\pm 10\%$, 50 V Mylar	025-056-9-004
C407	2200 pF $\pm 10\%$, 50 V Mylar	020-296-9-004
C408	0.01 μ F $\pm 10\%$, 50 V Ceramic	020-296-9-001
C409	10 pF ± 0.5 pF, 50 V Ceramic	020-142-9-003
C410	10 pF ± 0.5 pF, 50 V Ceramic	020-142-9-003
C411	220 μ F, 25 V Electrolytic	022-086-9-003
C412	100 μ F, 16 V Electrolytic	022-073-9-002
C413	0.1 μ F, 12 V Semiconductor Ceramic	033-018-9-001
C414	47 μ F, 16 V Electrolytic	022-090-9-003
C415	0.01 μ F $\pm 10\%$, 50 V Ceramic	020-296-9-001
C416	0.01 μ F $\pm 10\%$, 500 V Ceramic	020-296-9-007
C417, 418	1 pF ± 0.25 pF, 500 V Ceramic	020-142-9-008
C419, 420	0.01 μ F $\pm 20\%$, 50 V Ceramic (Model 1530 only)	020-124-9-003
C421, 422	33 pF $\pm 5\%$, 50 V Ceramic	020-238-9-001
C423, 424	120 pF $\pm 5\%$, 50 V Ceramic	020-103-9-001
C425	0.01 μ F $\pm 10\%$, 50 V Ceramic (Model 1530 only)	020-296-9-001
C426, 427	3300 pF $\pm 20\%$, 500 V Ceramic (Model 1530 only)	020-149-9-004
C428, 429	0.01 μ F $\pm 10\%$, 500 V Ceramic	020-296-9-007
C430	0.1 μ F, 12 V Semiconductor Ceramic	033-018-9-001
C431	0.01 μ F $\pm 10\%$, 50 V Ceramic	020-296-9-001
C432	0.1 μ F, 12 V Semiconductor Ceramic	033-018-9-001
C433	100 μ F, 10 V Electrolytic	022-123-9-002
C434	220 μ F, 25 V Electrolytic	022-086-9-003
C435	0.1 μ F, 12 V Semiconductor Ceramic	033-018-9-001
C436	100 μ F, 25 V Electrolytic (Model 1530 only)	022-123-9-001
C437	82 pF, $\pm 5\%$, 50 V Ceramic	020-250-9-002
C439	220 pF $\pm 5\%$, 50 V Ceramic	020-124-9-008
C442	15 pF $\pm 5\%$, 50 V Ceramic (Model 1530 only)	020-142-9-009
C443, 444	1000 pF $\pm 10\%$ 50 V (Model 1525 only)	020-296-9-005
TC401	20 pF Trimmer (Model 1530 only)	028-039-9-001
TC402, 403	10 pF Trimmer	028-033-9-002
TC404	20 pF Trimmer (Model 1530 only)	028-039-9-001

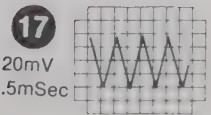
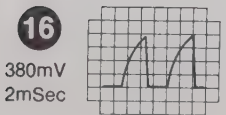
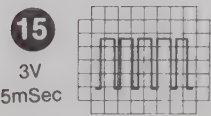
SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NUMBER
DIODES		
D401, 402	1S1587 Silicon Diode.....	151-048-9-001
D403	WZ130 Zener Diode, 13 V	152-076-9-001
D404	WZ050 Zener Diode, 5.0 V	151-069-9-001
D405, 406	1S1555 Silicon Diode.....	151-028-9-001
D407	WZ050 Zener Diode, 5.0 V	151-069-9-001
D408, 409	1S1587 Silicon Diode.....	151-048-9-001
TRANSISTORS		
Q401-404	2SC535-B NPN Silicon Signal Transistor	151-036-9-001
Q405-409	2SC458-C NPN Silicon Signal Transistor	176-016-9-001
Q410, 411	2SC1628-Y NPN Silicon Signal Transistor	176-055-9-005
Q412, 413	2SA818-Y PNP Silicon Signal Transistor	176-075-9-001
Q414, 415	2SK19-GR FET (Model 1530 only)	182-029-9-001
Q416, 417	2SC1047-C NPN Silicon Signal Transistor (Model 1530 only)	176-075-9-001
Q418, 419	2SC458-C NPN Silicon Signal Transistor	176-016-9-001
MISCELLANEOUS		
L401	47 μ H Inductor	041-068-9-002
L402, 403	1 μ H Inductor (Model 1530 only)	041-082-9-001
L406	22 μ H Inductor	041-089-9-001
TH401-403	Thermistor, SDT-1000.....	005-003-9-002

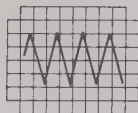
SCHEMATIC DIAGRAMS AND CIRCUIT BOARD MAPS

	Page
Vertical Amplifier	91
Vertical Output Amplifier	94
Sweep Board	96
Power Supply Board	99
Overall Schematic Diagram, Model 1530	101
Overall Schematic Diagram, Model 1525	102

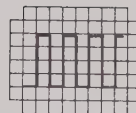


Taken in Chop mode.





A

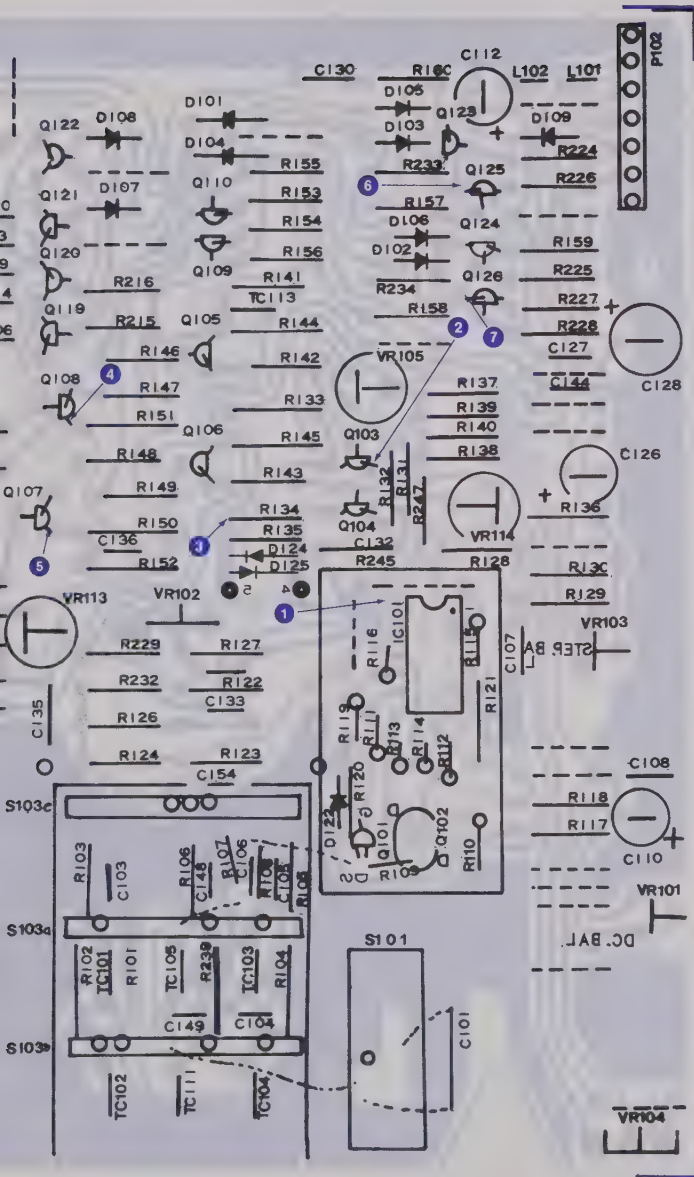


B

P-P VOLTS	SCOPE SWEEP	WAVE- FORM	TAKEN AT
22mV	0.5mS	A	Q105 Collector
20mV	0.5mS	A	Q106 Collector
44mV	0.5mS	A	Q107 Collector
24mV	0.5mS	A	Q115 Collector
24mV	0.5mS	A	Q116 Collector
22mV	0.5mS	A	Q117 Collector
1.5V	5mS	B	Q109 Collector MODE : DUAL
1.5V	5mS	B	Q110 Collector MODE : DUAL
1.5V	5mS	B	Q119 Collector MODE : DUAL
1.5V	5mS	B	Q120 Collector MODE : DUAL
1.5V	5mS	B	Q121 Collector MODE : DUAL
1.5V	5mS	B	Q122 Collector MODE : DUAL
150mV	0.5mS	A	Q125 Emitter
150mV	0.5mS	A	Q126 Emitter

ITEM	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PIN 10	PIN 11	PIN 12	PIN 13	PIN 14
IC103														
(1)	1.62V	1.62V	0.09V	3.58V	3.58V	0.09V	0V	4.10V	0.11V	0.11V	0.11V	3.58V	4.76V	4.96V
(2)	1.62V	1.62V	0.09V	3.69V	3.69V	0.09V	0V	4.10V	0.11V	0.11V	0.11V	3.69V	4.65V	4.96V
(3)	0.09V	0.09V	3.89V	3.64V	3.64V	0.09V	0V	4.10V	0.11V	0.11V	0.11V	3.65V	4.71V	4.96V
(4)	1.62V	1.62V	0.09V	3.59V	3.59V	0.18V	0V	4.10V	0.11V	0.11V	0.11V	3.59V	4.65V	4.96V
ITEM	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PIN 10	PIN 11	PIN 12	PIN 13	PIN 14
IC104														
(1)	4.96V	3.01V	4.96V	4.96V	4.96V	0.15V	0V	6.63V	4.96V	4.96V	4.96V	2.32V	0.68V	4.96V
(2)	4.96V	0.68V	4.96V	4.96V	4.96V	6.65V	0V	0.15V	4.96V	4.96V	4.96V	2.35V	3.02V	4.96V
(3)	4.96V	2.13V	4.96V	4.96V	4.96V	3.40V	0V	3.40V	4.96V	4.96V	4.96V	2.36V	2.13V	4.96V
(4)	4.96V	0.83V	4.96V	4.96V	4.96V	6.63V	0V	6.63V	4.96V	4.96V	4.96V	0.89V	0.84V	4.96V

- (1) Reading taken in CH A Position.
 (2) Reading taken in CH B Position.
 (3) Reading taken in DUAL Position.
 (4) Reading taken in ADD Position.



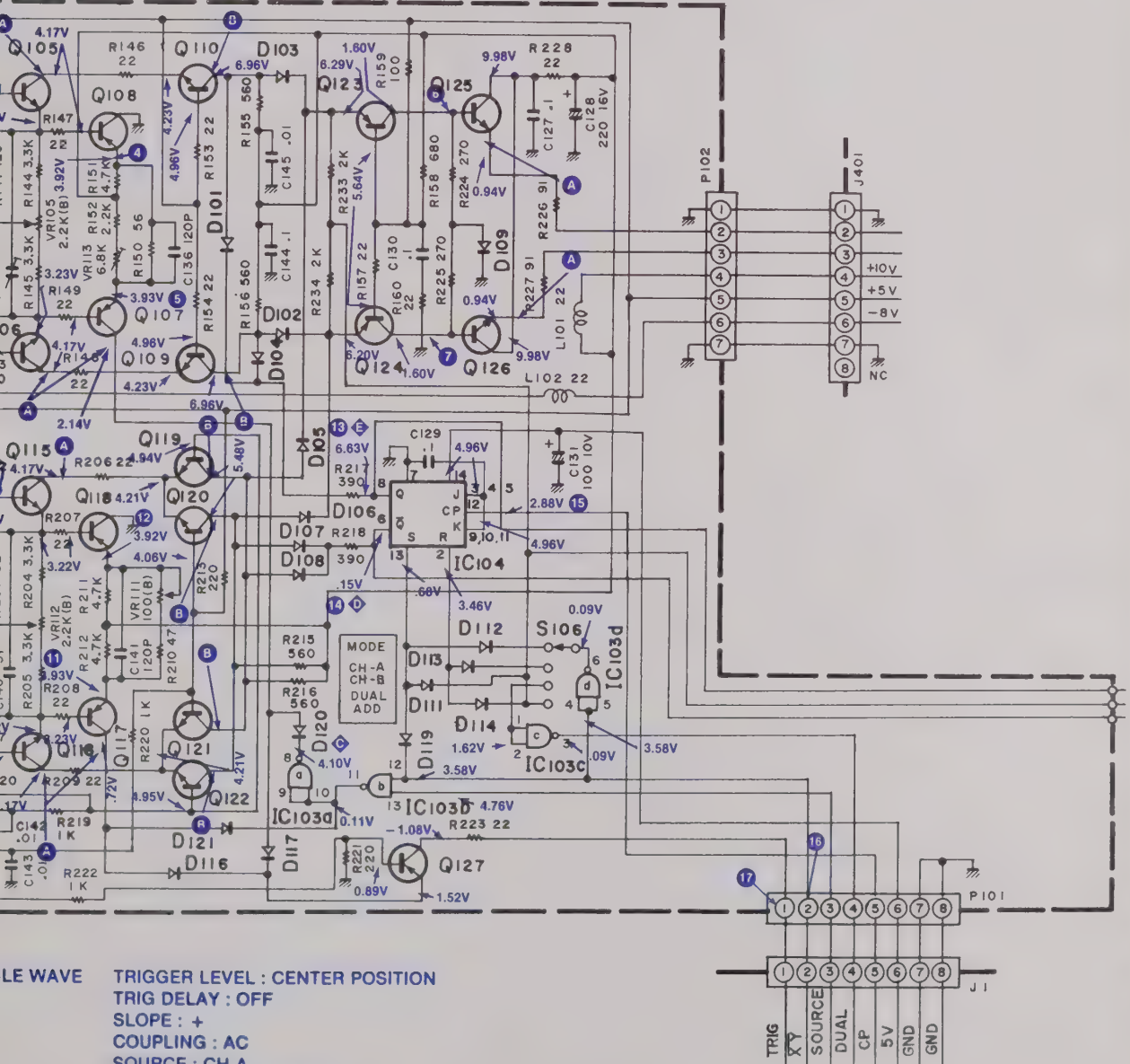
Q101,111:2SK30A(O) Q102,112:2SK228T-283 Q103~106,109,110,113~116,117,118,119,120,121,122,123,124:2SK228T-283
D101~108,122,123:1S1587 D109,111~114,116,117,119~121:1S1555 D124:1S1555



TEST CONDI
 INPUT SIGNAL : 0.6V
 INPUT : AC
 VOLTS/DIV : .1 V
 MODE : CH A
 INTENSITY : MAXIMU
 SWEEP TIME/DIV : .5
 HOLD/OFF : MAX
 CHOP : OFF
 TRIG MODE : NORM.

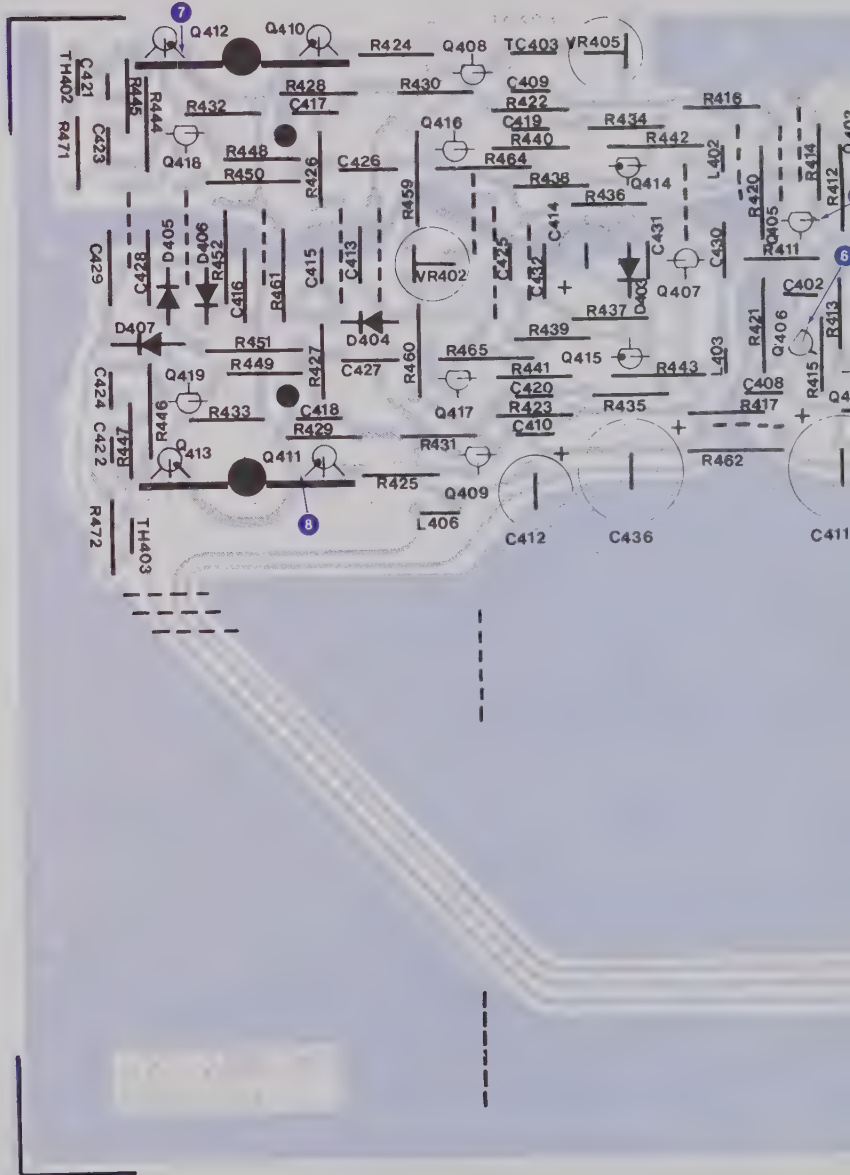
SCHEMATIC DIAGRAM, VERTICAL AMPLIFIER

,125,126:2SC535(B) Q107,108,117,118:2SA838(C) Q123,124,127:2SA844(D)
 IC101,102:HA1127 IC103:TD3400 IC104:TD3472



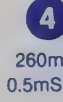
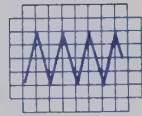
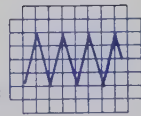
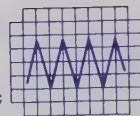
CIRCUIT BOARD MAP, VERTICAL OUTPUT AMPLIFIER

X73-1220-00



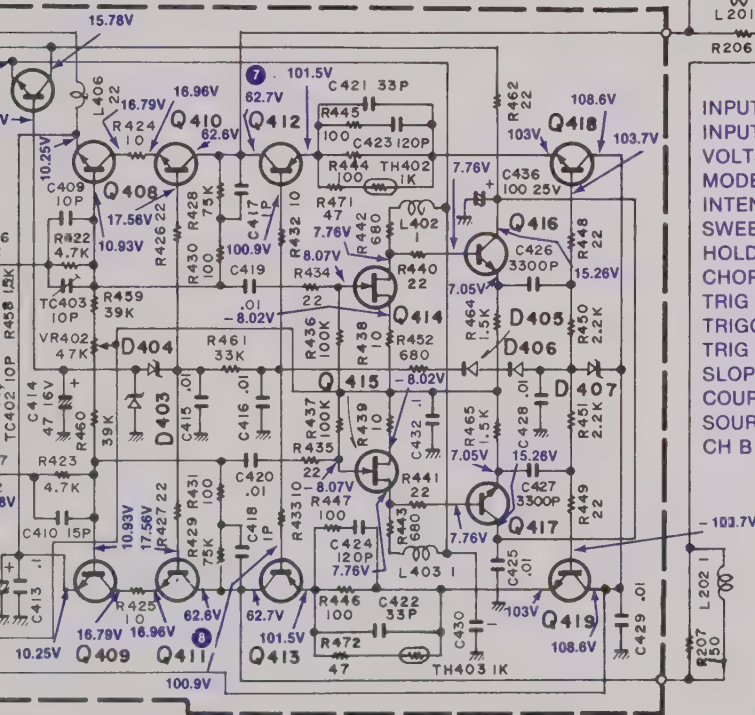


Q401~404:2S0
Q412,413:2SAB



SCHEMATIC DIAGRAM, VERTICAL OUTPUT AMPLIFIER

Q 405 ~ 409, 418, 419 : 2SC458(C) Q 416, 417 : 2SC1047(C) Q 410, 411 : 2SC1628(Y)
Q 414, 415 : 2SK19(GR)  D 401, 402 : 1S1587

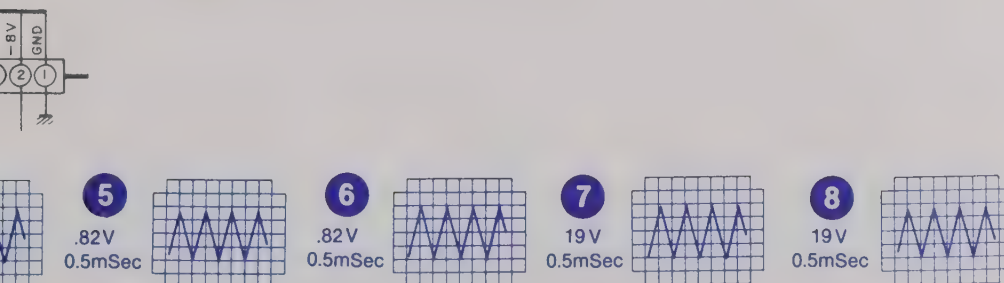


TEST CONDITIONS

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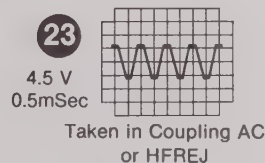
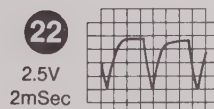
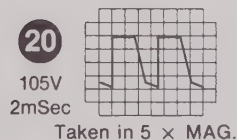
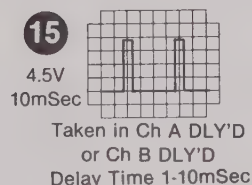
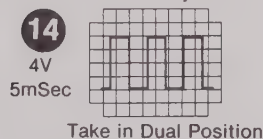
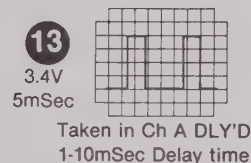
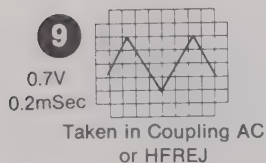
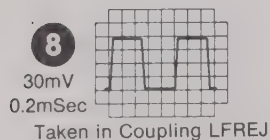
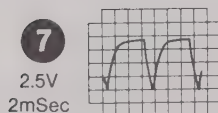
INPUT SIGNAL : 0.6V P-P TRIANGLE WAVE
INPUT : AC
VOLTS/DIV : .1 V
MODE : CH A
INTENSITY : MAXIMUM
SWEEP TIME/DIV : .5mS
HOLDOFF : MAX
CHOP : OFF
TRIG MODE : NORM, LINE
TRIGGER LEVEL : CENTER POSITION
TRIG DELAY : OFF
SLOPE : +
COUPLING : AC
SOURCE : CH A
CH B POLARITY : NORM

```

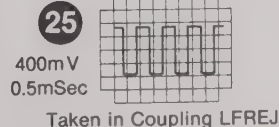




3 SAME AS **2**



24 SAME AS



26 SAME AS **25**

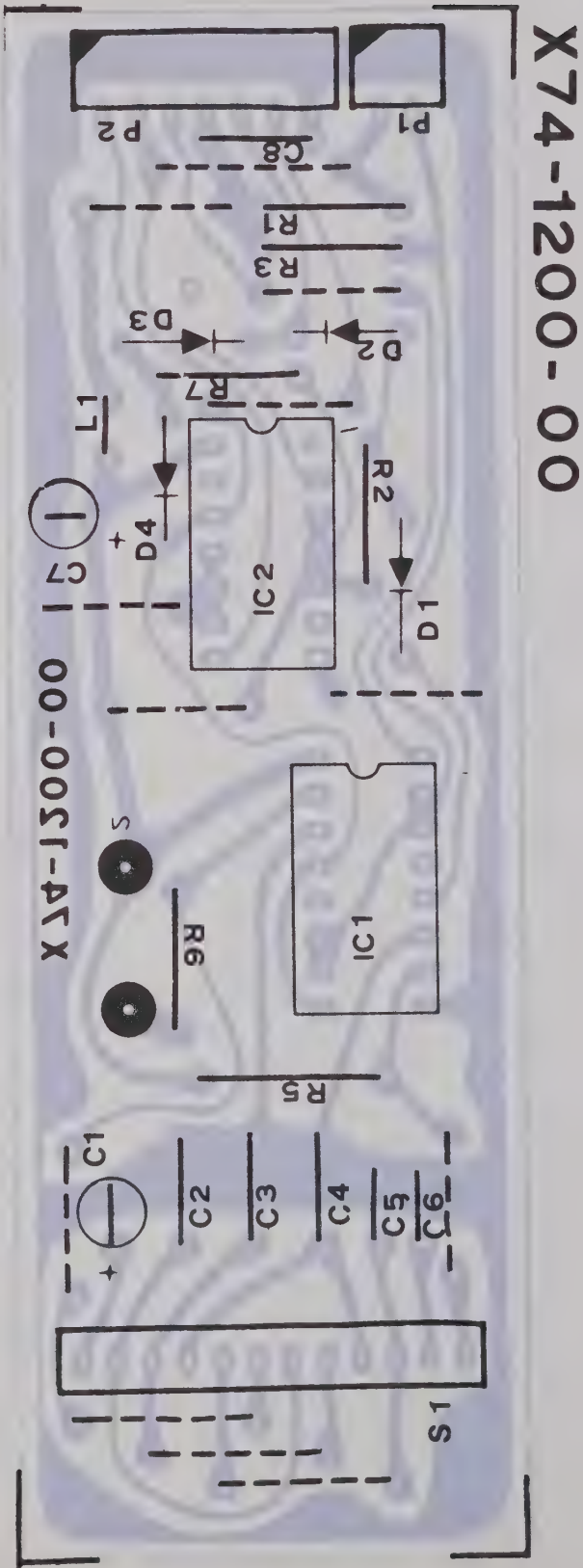
TEST CONDITIONS

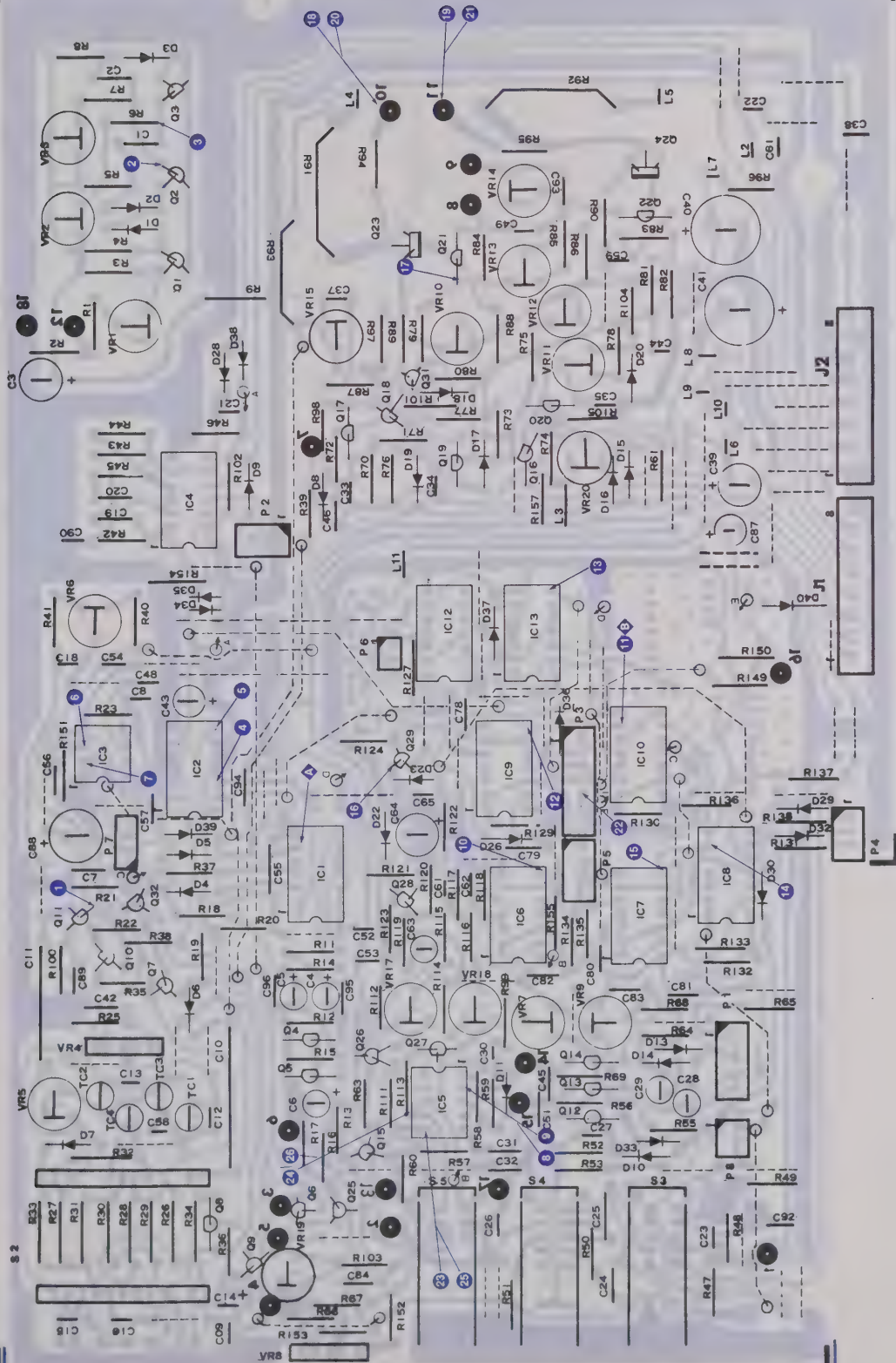
INPUT SIGNAL : 0.6V P-P TRIANGLE WAVE
INPUT : AC
VOLTS/DIV : .1 V
MODE : CH A
INTENSITY : MAXIMUM
SWEEP TIME/DIV : .5mS
HOLD OFF : MAX
CHOP : OFF
TRIG MODE : NORM, LINE
TRIGGER LEVEL : CENTER POSITION
TRIG DELAY : OFF
SLOPE : +
COUPLING : AC
SOURCE : CH A
CH B POLARITY : NORM

9, 11, 13, 16-19, 21, 22, 25-29, 31-33
 : 2SC945(P)
 : 2SA733(Q) Q14 : 2SK228T(2,2)
 : 2SK30A(O)
 : 2SC535(C)
 : 2SC1507
 : 10, 15, 17~20, 22, 23, 26, 28, 29, 32~40
 : 1S1555
 : IN60 IC1 : SN74H00N
 : 1S1587 IC2, 13 : SN74H72
 : YZ-030 IC3 : NJM555D
 IC4 : SN7400N
 IC5 : RC733T
 IC6~10, 12 : SN74LS00N

*NOT TRIGGERED + TRIGGERED **NORMAL ++







1. 100mSec Delay time

2. 3.6V 10μSec

3. 36V 10μSec

4. 56V 2mSec

5. 42V 2mSec

6. 2.5V 20μSec

7. 4.8V 2mSec

8. 15.28V

9. 17.04V

10. -0.61V

11. -1.18V

12. -1565V

13. -1500V

14. 75V

15. 62.7V

16. 62.7V

17. 79.8V

18. 10V

19. 10V

20. 10V

21. 10V

22. 10V

23. 10V

24. 10V

25. 10V

26. 10V

27. 10V

28. 10V

29. 10V

30. 10V

31. 10V

32. 10V

33. 10V

34. 10V

35. 10V

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293. 10V

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295. 10V

296. 10V

297. 10V

298. 10V

299. 10V

300. 10V

301. 10V

302. 10V

303. 10V

304. 10V

305. 10V

306. 10V

307. 10V

308. 10V

309. 10V

310. 10V

311. 10V

312. 10V

313. 10V

314. 10V

315. 10V

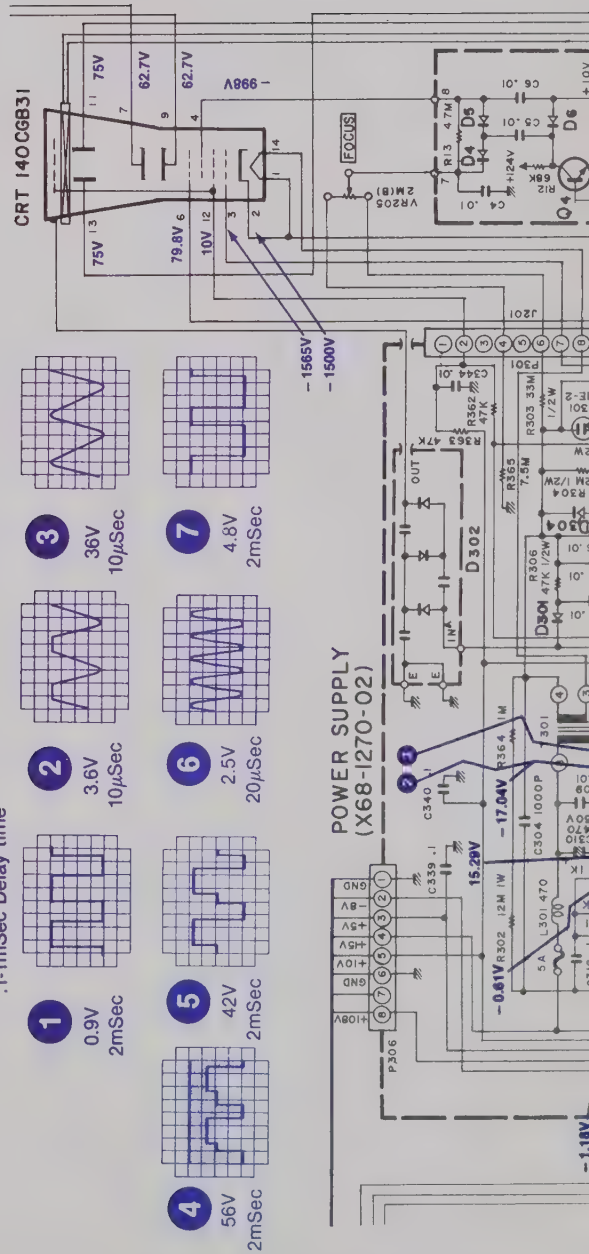
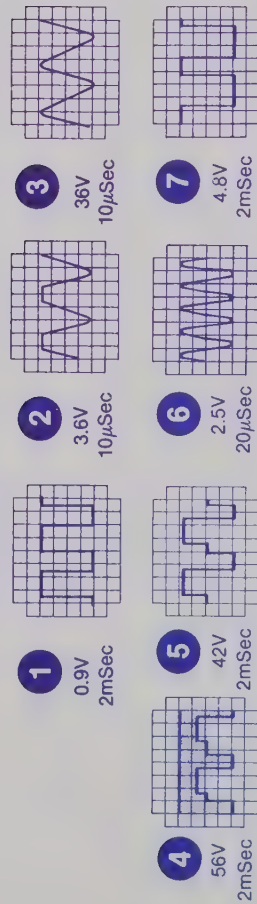
316. 10V

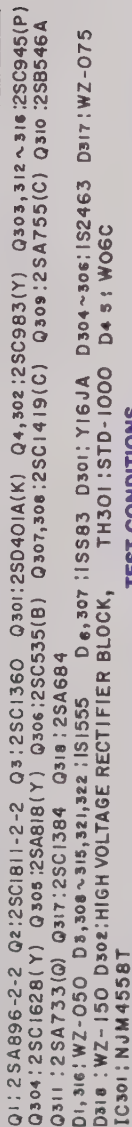
317. 10V

318. 10V

319. 10V

3

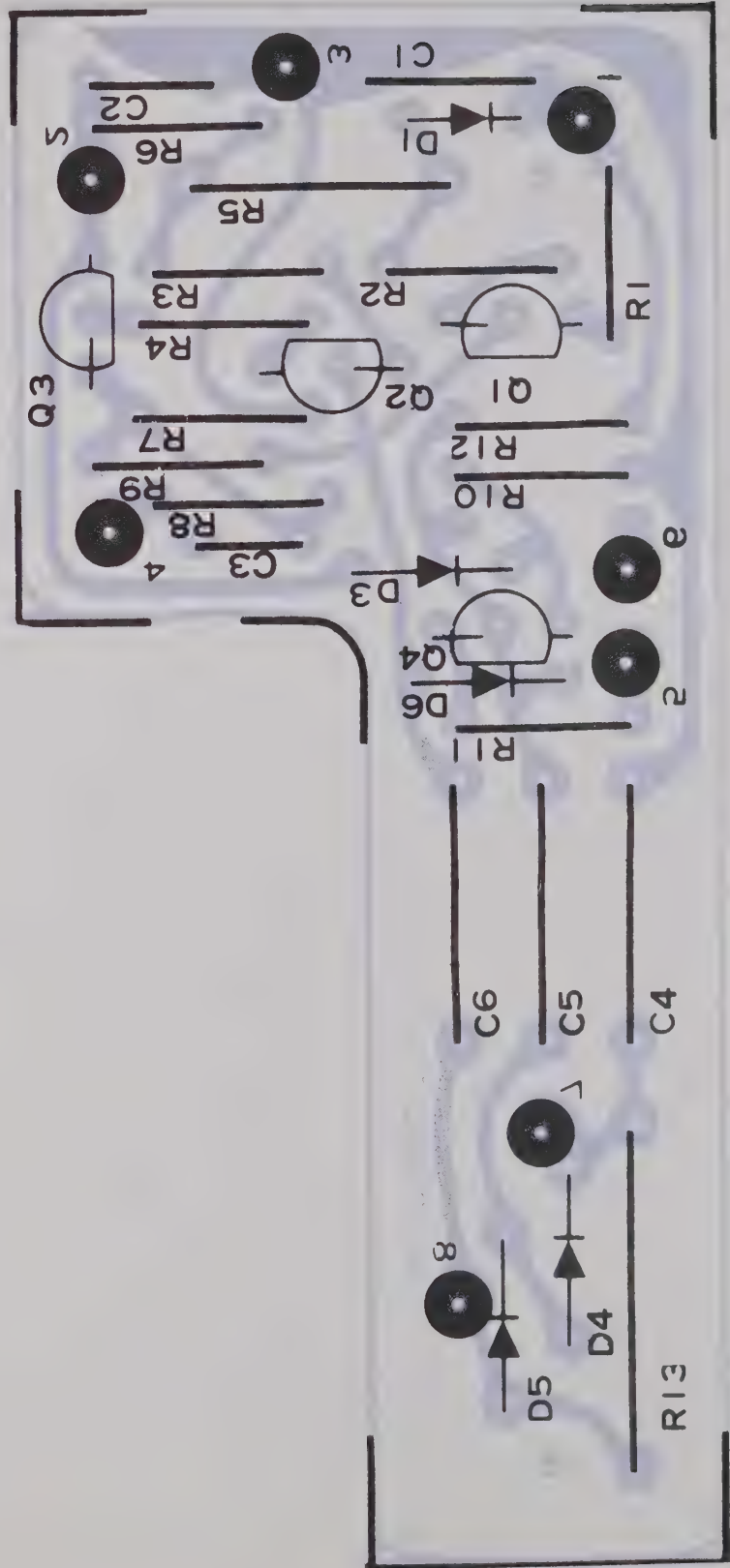




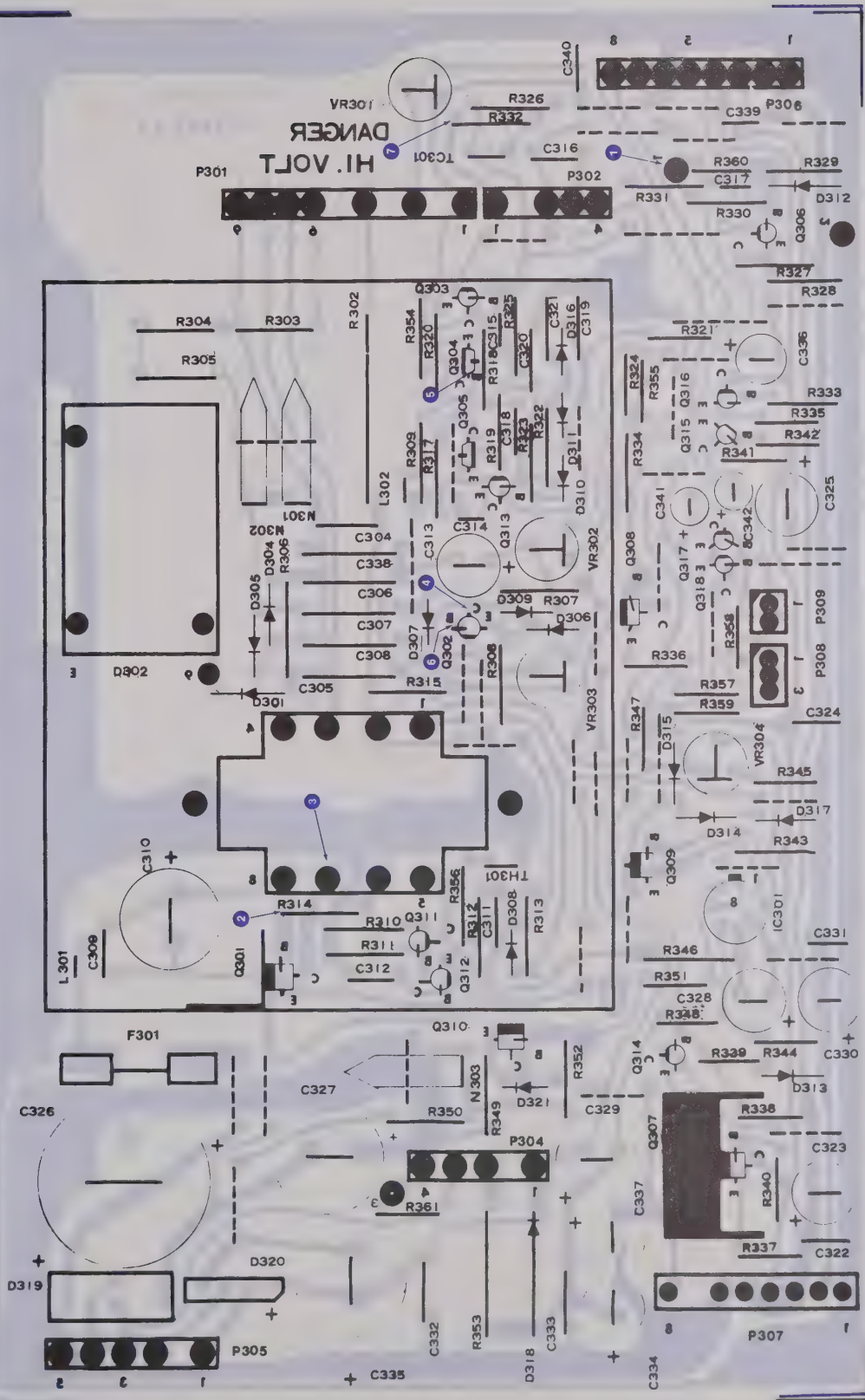
TEST CONDITIONS

INPUT SIGNAL : 0.6V P-P TRIANGLE WAVE
 INPUT : AC
 VOLTS/DIV : 1 V
 MODE : CH A
 INTENSITY : MAXIMUM
 SWEEP TIME/DIV : 5mS
 HOLDOFF : MAX
 CHOP : OFF
 TRIG MODE : NORM, LINE
 TRIGGER LEVEL : CENTER POSITION
 TRIG DELAY : OFF
 SLOPE : +
 COUPLING : AC
 SOURCE : CH A
 CH B POLARITY : NORM

X68-1270-02

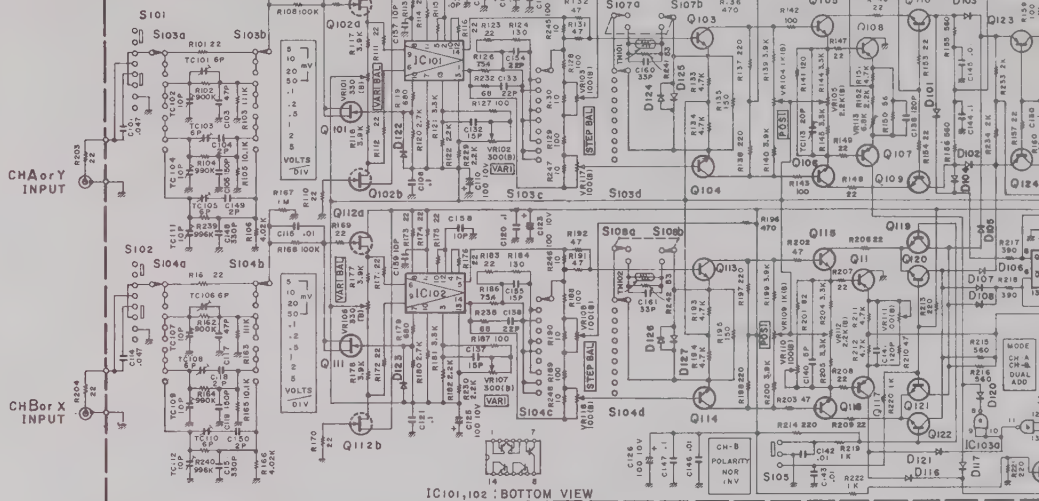


X68-1270-02

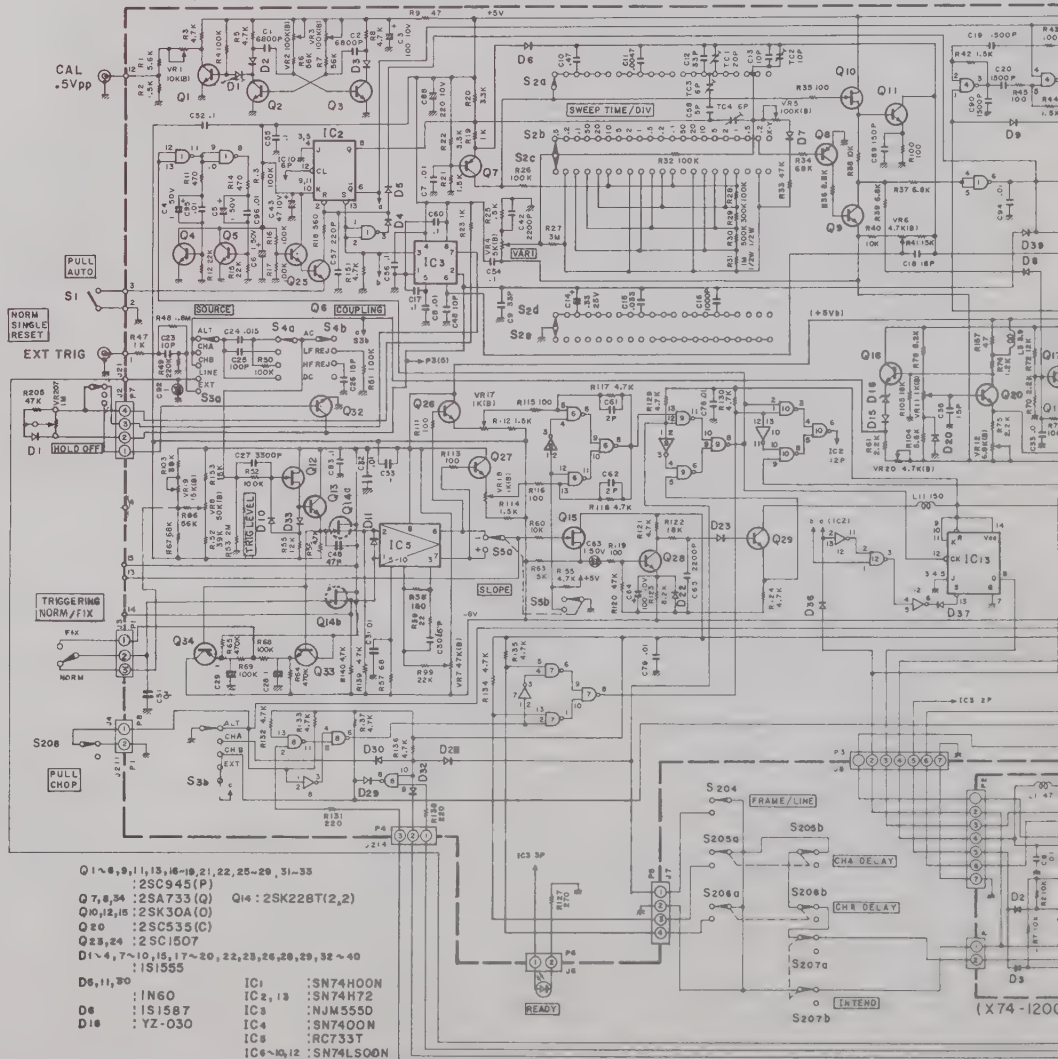


VERTICAL AMP (X73-1210-02)

Q 101,111 : 2SK30A(O) Q 102,112 : 2SK228T-2B3 Q 103~108,109,110,113~116,119~122,125,126 : 2SC535(B) Q 107,108,117,118 : 2SC535(B) D 101~106,122,123 : 1S1587 D 109,111~114,116,117,119~121 : 1S1555 D 124,127 : 1N60 IC 101,102 : HA1127 IC 103 : T

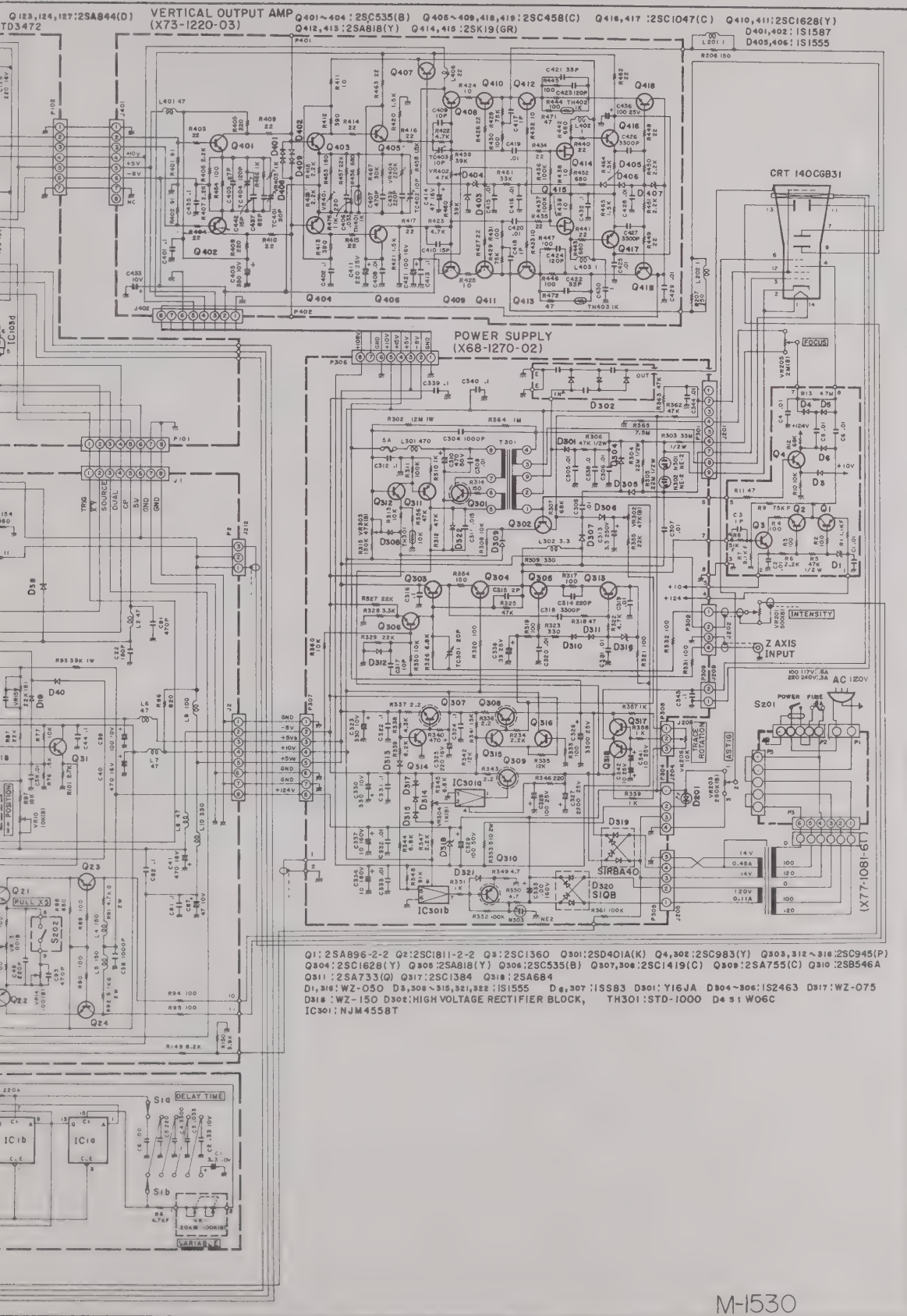


SWEEP (X74-1190-00)



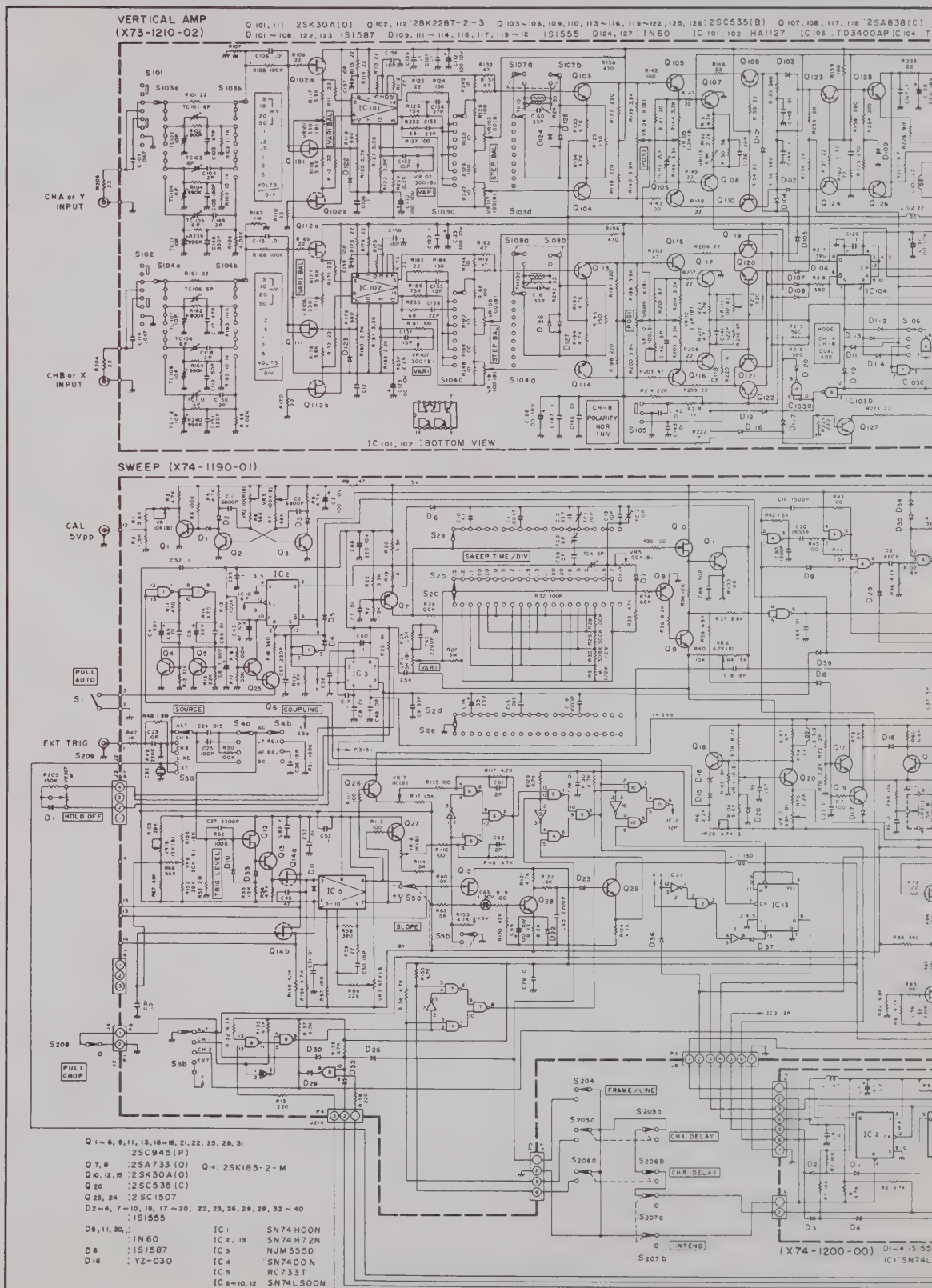
Q 1~6,9,11,13,16~19,21,22,25~29,31~33 : 2SC945(P)
Q 7,8,34 : 2SA733(Q) Q 4 : 2SK228T(2,2)
Q 10,12,15 : 2SK30A(O)
Q 20 : 2SC535(C)
Q 23,24 : 2SC1507
D 1~4,7~10,15,17~20,22,23,26,28,29,32~40 : 1S1555
D 6,11,30 : 1N60 IC 1 : SN74H00N
D 8 : 1S1587 IC 2,13 : SN74H72
D 16 : YZ-030 IC 3 : NJM5550
IC 4 : SN7400N
IC 5 : RC733T
IC 6~10,12 : SN74LS00N

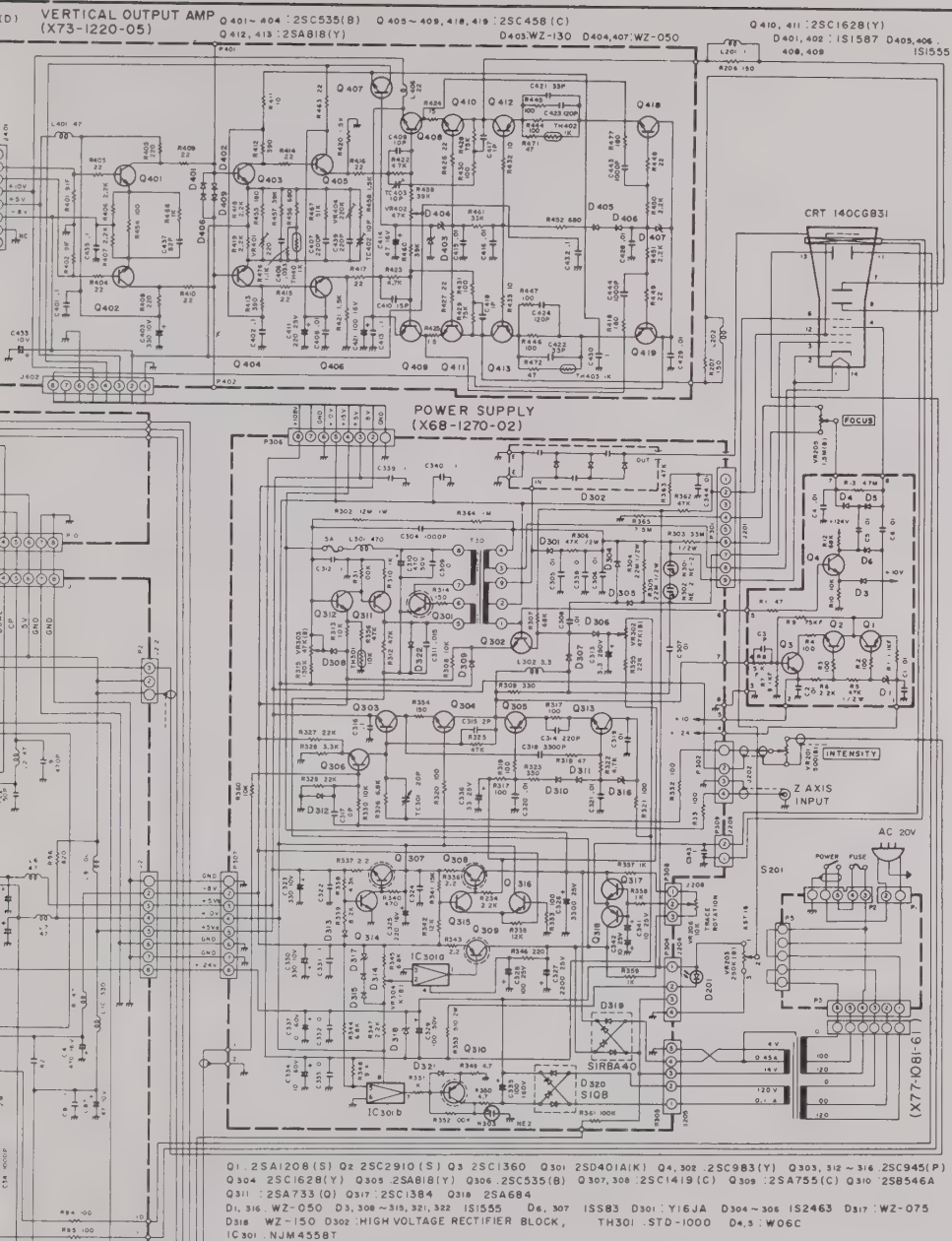
OVERALL SCHEMATIC DIAGRAM, MODEL 1530



M-1530

OVERALL SCHEMATIC DIAGRAM, MODEL 1525





The circuit elements may be changed without notice owing to a technical innovation.

HISTORY OF PRODUCTION CHANGES

The schematic diagrams and parts lists in this manual reflect the Model 1525 at the start of production and Model 1530 for serial numbers 07-05051 to 07-05150. Watch for any addendums that may be issued or inserted loose in the manual which cover production changes that may occur after this manual is printed. If possible, use the schematic diagram and parts list that was packed with your oscilloscope. These diagrams are updated frequently to reflect production changes.

IMPORTANT

1. When servicing Model 1530 with serial number 07-05050 or lower, refer to the following *HISTORY OF PRODCUTION CHANGES*, which itemizes differences between the unit you are servicing and the schematic diagrams and parts lists found elsewhere in this manual. Changes are listed in reverse chronological order, that is, starting at serial number 07-05050 and going backward to the start of production (serial number 07-04001). Changes are cumulative; trace backward through all the revisions until you reach the serial number for the unit you are servicing. For example, if you are servicing the unit with serial number 07-04826, it contains the differences listed for Serial No. 07-05050 and Lower, plus the differences listed for Serial No. 07-05000 and Lower, plus the differences listed for Serial No. 07-04900 and Lower.
2. In most cases, circuit changes involve several components which function as a group. Replacement of an individual component should be of the original type part to assure compatibility with the balance of the circuit. In those cases where improved performance or reliability can be achieved with the newer replacement component, and still assure compatibility, it is so recommended.

SERIAL NUMBER 07-05050 AND LOWER

Sweep Board Differences:

R57 was $68\ \Omega \pm 5\%$, 1/4 W. For replacement use $100\ \Omega \pm 5\%$, 1/4 W.

Main Chassis Differences:

Effective with serial number 07-05051 (which also coincides with the introduction of Model 1525), certain mechanical parts of the Model 1530 Chassis Assembly were revised to allow common use with Model 1525 -- and those parts are not compatible with the earlier Model 1530. For replacement, use the following parts in the earlier 1530's.

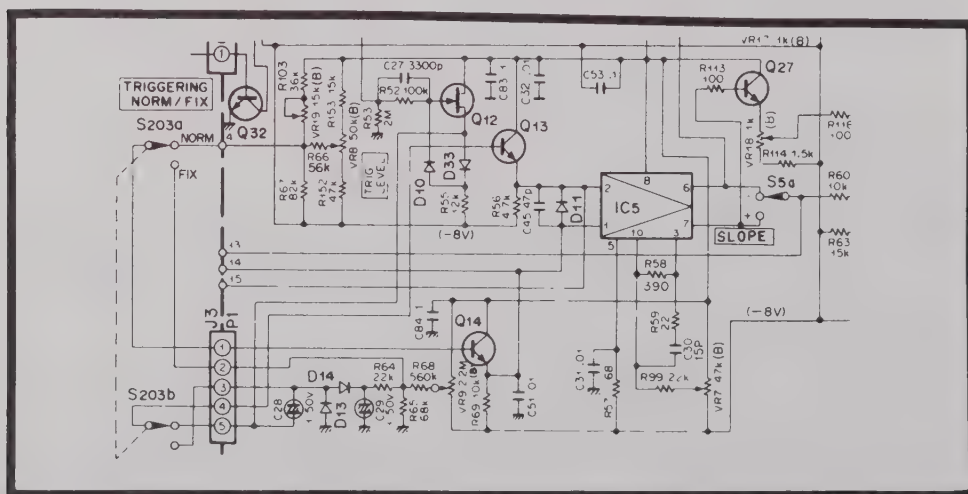
S203-207	5-Station Pushbutton Switch Assembly ..	088-063-9-001
	Die Cast Panel	255-197-9-001
	Hexagonal Boss	759-100-9-001
	Frame	254-039-9-001

SERIAL NUMBER 07-05000 AND LOWER

Sweep Board Differences:

Effective with Serial No. 07-05001, the FIX circuit was redesigned. For verification, check the circuit board identification; J25-2866-13 corresponds to the earlier circuit shown in Fig. 38, while J25-2886-23 corresponds to the later units shown elsewhere in this manual. For servicing earlier units, refer to the partial schematic diagram of Fig. 38, and use the following parts list for replacement parts:

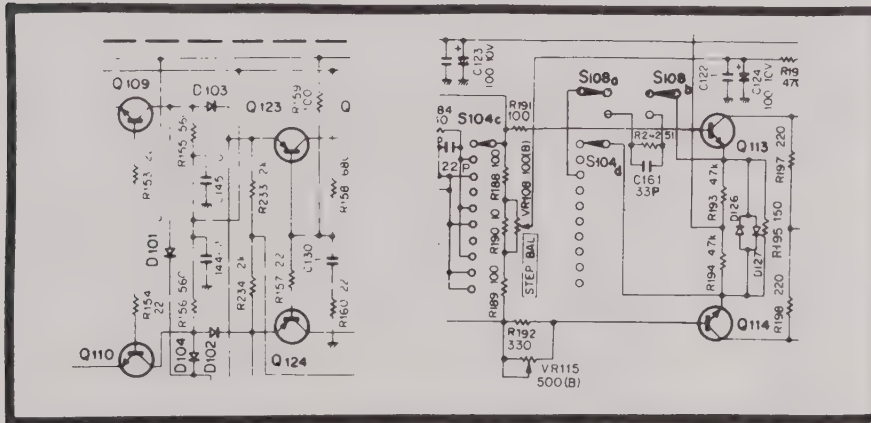
Q14	2SC945-P NPN Transistor	176-055-9-002
Q33	not used.	
Q34	not used.	
D13, 14	1N60 Diode	150-001-9-005
VR9	Potentiometer, 2.2 M Ω	008-298-9-014
R64	Carbon Resistor, 22 k Ω $\pm$ 5%, 1/4 W.	
R65	Carbon Resistor, 68 k Ω $\pm$ 5%, 1/4 W.	
R67	Carbon Resistor, 82 k Ω $\pm$ 5%, 1/4 W.	
R68	Carbon Resistor, 560 k Ω $\pm$ 5%, 1/4 W.	
R69	Carbon Resistor, 10 k Ω $\pm$ 5%, 1/4 W.	
R103	Carbon Resistor, 36 k Ω $\pm$ 5%, 1/4 W.	
R139, 140	not used.	
R152	Carbon Resistor, 47 k Ω $\pm$ 5%, 1/4 W.	
R153	Carbon Resistor, 15 k Ω $\pm$ 5%, 1/4 W.	



Vertical Amplifier Board Differences:

Effective with Serial No. 07-05001, several related circuit changes were incorporated as a group into the vertical amplifier board. For earlier units, the circuit was as shown in Fig. 39. Replacement parts for these earlier units should be selected from the following parts list:

C122	Ceramic Capacitor, 0.01 μ F, 12 V	033-018-9-001
C124	Electrolytic Capacitor, 100 μ F, 10 V	022-123-9-002
C145	Ceramic Capacitor, 0.01 μ F, 50 V	020-142-9-012
C154	Ceramic Capacitor, 27 pF $\pm$ 5%, 50 V . . .	020-215-9-003
R123, 183	Carbon Resistor, 10 Ω $\pm$ 5%, 1/4 W.	
R142, 143	Carbon Resistor, 47 Ω $\pm$ 5%, 1/4 W.	
R241, 242	Metal Film Resistor, 51 Ω $\pm$ 1%, 1/4 W	013-068-9-001
R249, 250	not used.	
S103, 104	Rotary Switch (Vertical Attenuator) . . .	083-262-9-001
VR102, 107	Potentiometer, 300 Ω (VARIABLE)	008-298-9-002
TH101, 102	not used.	



SERIAL NUMBER 07-04900 AND LOWER**Vertical Amplifier Board Differences:**

Q102 and Q112 were type 2SK228T-1-2. However, for replacement, use the type 2SK228T-2 or 2SK228T-3 that is listed in the parts list.

Main Chassis Assembly Differences:

R205 was $47\text{ k}\Omega \pm 5\%$, 1/4 W. For replacement use $150\text{ k}\Omega \pm 5\%$, 1/4 W.

SERIAL NUMBER 07-04650 AND LOWER**Power Supply Differences:**

Effective with Serial No. 07-04651, the Auto-Focus circuit was added. For compatibility with the added Auto-Focus board, several components and the wiring of the main power supply board were also changed. For verification, check the circuit board identification; J25-2861-23 corresponds to the earlier circuit shown in Fig. 40, while J25-2861-33 corresponds to the later units shown elsewhere in this manual. For servicing earlier units, refer to the partial schematic diagram of Fig. 40, and use the following parts list for replacement parts:

R302	Metal Film Resistor, $8.2\text{ M}\Omega \pm 5\%$, 1 W ..	004-171-9-001
R303	Carbon Resistor, $2.7\text{ M}\Omega \pm 5\%$, 1/2 W ...	002-102-5-275
R362	not used.	
R363	not used.	
R364	not used.	
R365	not used.	
C344	not used.	

Vertical Amplifier Board Differences:

Effective with Serial No. 07-04651, the 2 mV sensitivity circuit was changed. For verification, check the circuit board identification; J25-2806-83 corresponds to the earlier circuit shown in Fig. 41, while J25-2886-03 corresponds to the later units shown elsewhere in this manual. For servicing earlier units, refer to the partial schematic diagram of Fig. 41, and use the following parts list for replacement parts:

Q102, 112	2SK228-1-2 Dual FET	182-059-9-001
C154	Ceramic Capacitor, $15\text{ pF} \pm 5\%$, 50 V ...	020-142-9-009
VR117-118	not used.	
R245-248	not used.	

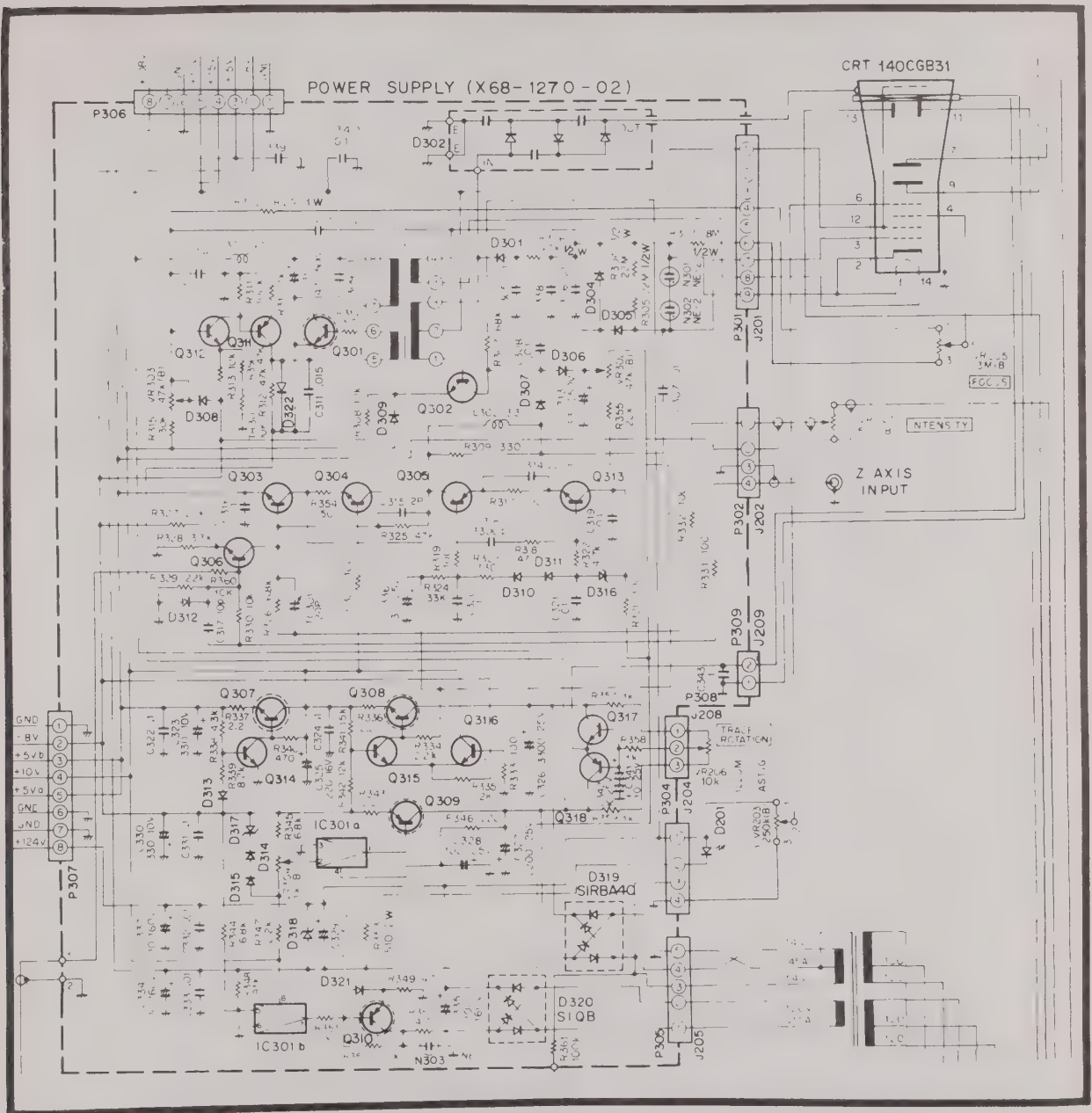


Fig. 40. Power Supply Circuit for Units with
Serial No. 07-04650 and Lower.

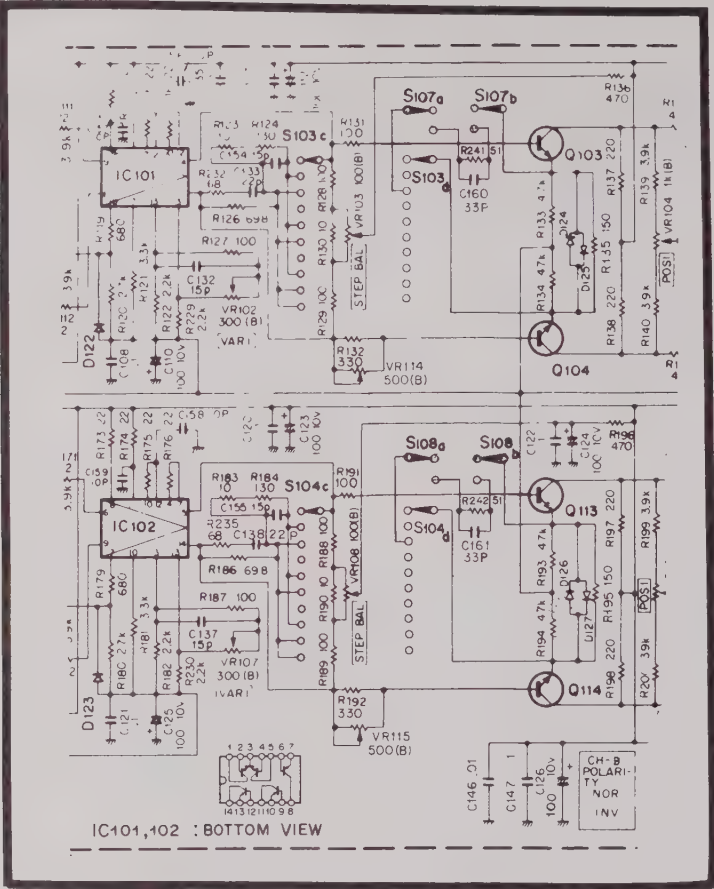


Fig. 41. 2 mV Sensitivity Circuit for Units with Serial No. 07-04650 and Lower.

SERIAL NUMBER 07-04301 AND LOWER

Sweep Board Differences:

Effective with Serial No. 07-04301, the sweep board identification was changed from J25-2866-03 to J25-2866-13. The circuit board layout was changed to accommodate all parts on the component side; some parts had been mounted on back of board previously.

Delay Time Board Differences:

Effective with Serial No. 07-04301, a few related component changes were incorporated as a group into the delay time board. The circuit board identification was changed from J25-2867-04 to J25-2867-14. For earlier units, use the following parts list:

S1/VR1	Rotary Switch with Dual Variable Resistor (DELAY TIME control)	083-262-9-002
D3, D4	not used.	
R4	Carbon Resistor, 4.7 k Ω $\pm$ 5%, 1/4 W.	
R7	not used.	
C2	Tantalum Capacitor, 0.33 μ F 10 V	027-051-9-002

Vertical Amplifier Board Differences:

VR101 106	Potentiometer, 470 Ω	008-341-9-013
C160, 161	Ceramic Capacitor, 100 pF $\pm$ 5%, 50 V ..	020-142-9-007
R241, 242	Metal Film Resistor, 33 Ω $\pm$ 1%, 1/4 W ..	013-048-9-003

Vertical Output Amplifier Differences:

Effective with Serial No. 07-04301, a new Vertical Output Amplifier Assembly was used. The identification of the earlier assembly is X73-1220-02, while the later assembly is designated X73-1220-03. Correspondingly, the circuit board identification was changed from J25-2867-04 to J25-2867-14. Use of the later assembly also requires compatible changes on the main chassis (see above). The earlier (-02) assembly was very similar to later (-03) assembly, except for the following parts:

L407, 408	Ferri-Inductor	041-089-9-002
L201-202	not used.	
R474, 475	Carbon Resistor, 150 Ω $\pm$ 5%, 1.4 W.	
R206-207	not used.	
R457	Carbon Resistor, 22 k Ω $\pm$ 5%, 1/4 W.	
R467	Carbon Resistor, 30 k Ω $\pm$ 5%, 1/4 W.	
C407	Ceramic Capacitor, 470 pF $\pm$ 10%, 50 V .	020-248-9-002
C437	Ceramic Capacitor, 120 pF $\pm$ 5%, 50 V ..	020-103-9-001

Power Supply Differences:

Effective with Serial No. 07-04301, the trace rotation circuit was redesigned. The trace rotation coil was changed from a dc coil resistance of 220 ohms to 150 ohms and the driver circuit which includes Q317, Q318, and R303 on the power supply were changed for compatibility. For convenience, a complete parts list for both the earlier and later circuit is included:

Earlier Version (Serial No. 07-04300 and lower)

	Trace Rotation Coil, 220 ohms	041-125-9-001
Q317	2SC945-P NPN Transistor	176-055-9-002
Q318	2SA733-Q PNP Transistor	177-018-9-001
R303	Carbon Resistor, 1.8 M Ω $\pm$ 5%, 1/2 W.	

HISTORY OF PRODUCTION CHANGES

Later Version (Serial No. 07-04301 and higher)

	Trace Rotation Coil, 150 ohms	041-132-9-001
Q317	2SC1384 NPN Transistor	176-109-9-001
Q318	2SA684 PNP Transistor	177-046-9-001
R303	Carbon Resistor, 2.7 M Ω $\pm$ 5%, 1/2 W.	

Main Chassis Differences:

VR205	Variable Resistor, 3 M Ω (FOCUS Control)	008-390-9-001
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SERIAL NUMBER 07-04151 AND LOWER

Delay Time Board Differences:

D2	not used.	
R2	Carbon Resistor, 4.7 k Ω $\pm$ 5%, 1/4 W	

Sweep Board Differences:

Q32	not used.	
D39, 40	not used.	
R10	Carbon Resistor, 4.7 k Ω $\pm$ 5%, 1/4 W.	
R11, 14	Carbon Resistor, 1.5 k Ω $\pm$ 5%, 1/4 W.	
R47	Carbon Resistor, 22 Ω $\pm$ 5%, 1/4 W.	
R58	Carbon Resistor, 180 Ω $\pm$ 5%, 1/4 W.	
R62	Carbon Resistor, 100 Ω $\pm$ 5%, 1/4 W.	
R97	Carbon Resistor, 12 k Ω $\pm$ 5%, 1/4 W.	
R157	not used.	
C23	Ceramic Capacitor, 1 pF $\pm$ 0.5 pF, 50 V..	020-171-9-005
C30	Ceramic Capacitor, 47 pF $\pm$ 5%, 50 V . . .	020-144-9-004
C37	Ceramic Capacitor, 33 pF $\pm$ 5%, 50 V . . .	020-238-9-001
C50	Ceramic Capacitor, 2 pF $\pm$ 0.5 pF, 50 V..	020-250-9-004
C93-96	not used.	



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